

THE EAST MIDLAND DA GEOGRAPHER

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EDITORIAL NOTE

With the appearance of the fourth issue we should like to take the opportunity of thanking subscribers for their support of 'The East Midland Geographer'. That the venture of publishing a regional periodical has attained at least a modest success is shown by its wide circulation not only within the East Midlands but in other parts of the country and abroad. Particularly gratifying is the fact that it is received by a steadily increasing number of universities and other teaching and research institutions. It is appropriate and at the same time forgivable, we feel, to mention these facts, for the present session marks the coming-of-age of the Department of Geography as a separate and independent department of this University. Since this event twenty-one years ago, a considerable number of graduates from the Department have contributed, by their own scholarship and through leading positions they now occupy, to the advancement of the subject.

We also express thanks to one of our contributors, Mr. A. G. Powell, who in this issue concludes his series of three valuable articles on population changes in the contiguous counties of Nottinghamshire, Derbyshire and Leicestershire which form so significant a part of the East Midlands. Within this group of counties, social and economic development, exhibiting close inter-relationships in the area of the middle Trent has become well adjusted to the terrain. These counties may therefore claim in some respect to be regarded as the core of the region—a region defined primarily upon a basis of human organisation.

THE EAST MIDLANDS AND POST-WAR DEVELOPMENT IN MANUFACTURING

W. B. JOHNSTON

The aim of the post-war Distribution of Industry Policy has been to ensure that industrial development, including the extension of existing factories and the building of new ones is "carried out consistently with the proper distribution of industry"⁽¹⁾. This may be interpreted as an attempt not only to solve the employment problems of the Development Areas but also to tap reserves of labour elsewhere. In essence therefore the Policy has been to guide development into areas where unused labour is available and it is not surprising that this aspect of planning has been the subject of criticism and conflicting opinions.

The purpose of this paper is to examine the results of such development within the planning region of the East Midlands. In this connection two points affecting the Distribution of Industry Policy must be clearly understood at the outset. Firstly, in pursuance of the Policy, the Board of Trade as the government department primarily concerned, does not possess powers to direct industry to particular locations but can only withhold approval of a location and by advice and encouragement stress the advantages of an alternative area. Secondly the Board of Trade is concerned only with the general location of industry, the control of actual factory sites being the responsibility of the local planning authority. This study deals therefore with the broader pattern of industrial development and not with the siting of manufacturing establishments.

THE EAST MIDLANDS

The East Midlands consists of Derbyshire (excluding the north-west which has closer economic ties with Lancashire), Nottinghamshire, Lincolnshire, Leicestershire, Rutland and Northamptonshire, including the Soke of Peterborough. This was one of the most prosperous regions of the country before the war, with unemployment figures much below the national average. In economic character, the East Midlands falls broadly into two divisions: firstly, the industrial west extending from the main coalfield in the north through to the footwear manufacturing belt in the south, and secondly, the agricultural east containing enclaves of manufacturing and including the holiday resorts of the Lincolnshire coast.

Although the Region has a favourable record with regard to employment fluctuations and contains no designated Development Area, there are certain problem areas. Of these, a number are susceptible to periodic unemployment, owing to their specific industrial character. They may be conveniently grouped into four types. The first includes the older coalfield districts around Chesterfield, Mansfield, Worksop, Alfreton and Coalville where the outstanding feature is the emphasis on coalmining which accounts for 25-45% of the insured population; secondly, the iron and steel centres of Scunthorpe and Corby which are

(1) *Town and Country Planning Act, 1947, Sec. 14(4).*

characterised by partial and indirect dependence on exports, by the dominance of capital goods industries, and by specialisation on iron and steel which employs 40—60% of the insured population ; thirdly, the specialized engineering centres of Gainsborough, Lincoln and Newark with their notable dominance of capital goods industries, dependence on exports, and marked emphasis on engineering which represents 20—35% of the insured population. In each of these engineering towns production is dominated by one or two large firms. Finally, there is the special case of Grimsby where 40% of the insured population is engaged in fishing and associated industries and where seasonal unemployment is substantial.

Another important aspect of manufacturing in the Region is the large number of female-employing industries such as textiles, clothing and footwear, and tobacco. In the large traditional centres such as Nottingham, Leicester and Northampton, a shortage of female labour has become intensified since the war. The availability of female labour is therefore critical. There appear to be four main types of centre which offer possibilities for firms seeking female labour. The first of these consists of the smaller coalmining towns, such as Clay Cross, Eckington, Bolsover, Staveley, and Swadlincote where small hidden⁽¹⁾ reserves are likely to be attracted into employment by light industries which will also employ females now travelling considerable distances to work. The low percentage of females in the insured population of these centres is a reflection of the journey to work and of the peculiar features of mining areas, notably the shift work of the men, high wages, early marriages, large families and a tradition of female non-employment. Next, there are the special centres of Scunthorpe and Corby, both of which are increasing rapidly in population and contain at present, few opportunities for female employment, though they contain considerable reserves of female labour. Into this category fall Gainsborough, where the present engineering industries are unsuitable for many females and where a reserve appears available for employment in light manufacturing, and Grimsby where the decline of fishing and associated industries has resulted in relatively high unemployment. Thirdly, the coastal holiday resorts of Mablethorpe and Skegness pose distinctive problems because of seasonal fluctuation : unemployment in winter and shortage of labour in summer. Lastly, there are the extensive rural areas where hidden reserves do exist but are small and scattered and thus likely to deter potential manufacturers ; moreover females are important in seasonal agricultural work. A separate and unique aspect relates to the role of northern Derbyshire and Nottinghamshire as a receiving ground for the overspill of industry and population from the congested area of Sheffield.

THE BASES OF ANALYSIS

The accompanying maps are based on data made available by the regional office of the Board of Trade at Nottingham. The post-war period is covered up to 31st March, 1953. The data is classified according to the Standard Industrial Classification of 1948 produced by the Central

(1) A "hidden reserve of labour is formed of those persons who could be attracted into employment in excess of the notified unemployed ("visible" reserve). Various quantitative indicators have been used by the Board of Trade to measure the "hidden" reserve.

Statistical Office. Only Orders III-XVI inclusive have been used as these constitute the manufacturing categories. Extensions to existing buildings, new constructions and movements into existing premises are included and, wherever possible, the figures for additional labour required for full production have been used. Where these statistics were not available, the actual additional labour employed was substituted. A further restriction to detailed interpretation should be noted. Sample surveys by the Board of Trade indicate that, in some instances, the additional labour originally indicated has not always been necessary.

The data does not cover all post-war developments in manufacturing because the Board of Trade's Industrial Development Certificate is required only where the floor space of the development is in excess of 5,000 square feet. Moreover, in order to be realistic, a development was included only if the records indicated that the construction of the building, or extension, or alteration, had actually begun since a number of projects despite official approval as to location never reach fruition.

On the basis of this data, map analysis has been made of movements into other regions by East Midland firms, of movements into the East Midlands by extra-Regional firms and of developments within the Region by East Midland firms. It is not possible within the scope of this paper, to analyse in detail the effectiveness of the Distribution of Industry Policy resulting from these changes. Rather it is hoped that this study may encourage further investigation by contributing to an understanding of the post-war pattern of manufacturing developments in the East Midlands.

MOVEMENTS OUT OF THE EAST MIDLANDS (1)

East Midlands firms have contributed significantly towards a more balanced distribution of industry in the national sense. Encouraged by the Board of Trade to move and discouraged from expanding locally by labour shortages, both male and female, numerous firms have established important branches outside the Region. The major contributions have been in textiles, notably hosiery, and in clothing both of which are large employers of female labour; in this and in other ways they are eminently suited to the requirements of the Development Areas into which they have mainly moved.(2)

The location of these post-war establishments is marked by regional concentration (Fig. 1*), by variations in number of employees and proportions of males and females, and by different regional combinations of manufacturing types. The largest and most significant movements have been to the Development Areas of the North-East Coast, South Wales and the Clyde Valley. The establishments on the North-East Coast are distinctive in that the major ones have occurred in Engineering, Shipbuilding and Electrical Goods, types of manufacturing which are

(1) In the analysis of movements into and out of the Region, the criteria for the inclusion of an establishment are that the parent firm must employ 100 or more persons and the establishment must still be in operation as at 31st March, 1953.

(2) D. C. Hague and P. K. Newman, *Costs in Alternative Locations: The Clothing Industry*, Natl. Instit. Econ. and Soc. Res., Occas. Papers XV, Cambridge, 1952.

* The circles on Figures 1, 2, 4, 5 and 6 are proportional in area to the numbers of workers involved but it has been considered advisable to omit the keys.

traditional to that area. In addition, a quarter of the twelve establishments concern themselves with Clothing and Textiles. Small, medium, and large employers of labour are found here with the emphasis on male labour, although a large number of females are also required. In contrast, the movements to South Wales are dominated by Clothing and Textiles with females forming most of the additional labour. These characteristics apply also to the Clyde Valley although, here, one large engineering development employing men is also included.

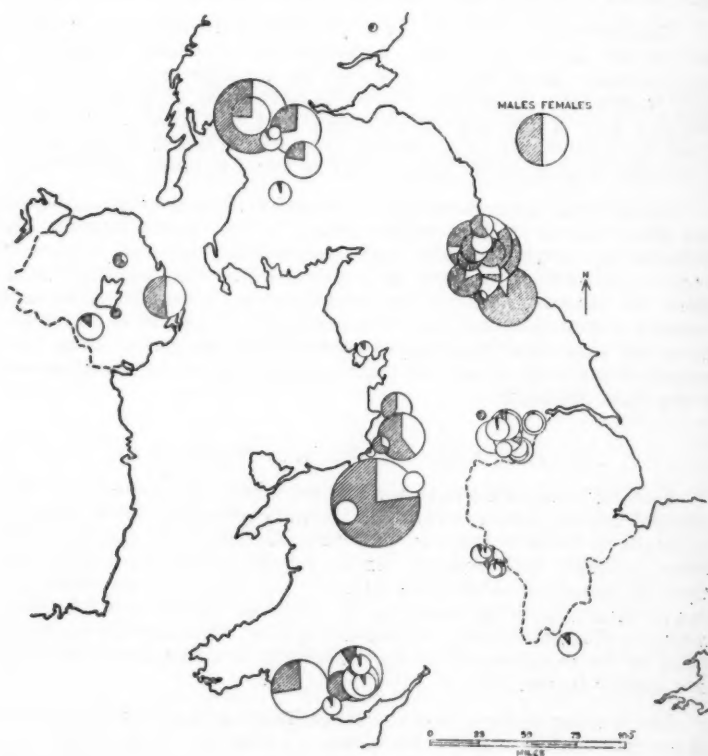


Fig. 1

Location and size of post-war developments in manufacturing by East Midland firms outside the Region : as at 31st March, 1953.

Movements to North Wales, Lancashire and Cheshire, and to Northern Ireland have also occurred. In the first area, a number of textile and clothing factories have been established with one very large textile concern in North Wales outstanding. It is this plant which accounts for the dominance of male employees. The movements to Northern Ireland give employment largely to females but have been few in number and of relatively small size ; yet, because of the distance

from the parent firms, they are significant. The higher costs of transport for branches in Northern Ireland, compared with their competitors in England, appear to be offset by local advantages, particularly in the greater ease of obtaining suitable labour. Marked satisfaction with results has been expressed by manufacturers with branches in Northern Ireland.

All these developments are associated with areas previously characterised by an unbalanced industrial structure and a shortage of work for special labour groups, particularly females. Somewhat different in character are the movements into two areas adjacent to the East Midlands Region. In the Nuneaton-Tamworth district on the south-western margin, six small establishments have been set up. They are engaged in the manufacture of clothing (notably footwear) and textiles employing a considerable number of females. Those engaged in the manufacture of boots and shoes concentrate on one stage of the manufacturing process and therefore have intimate links with the parent firms within the Region in Leicester and Northants. Also closely linked to parent firms are the numerous branches on the northern margin of the Region in south Yorkshire. These are again clothing and textile establishments, of small size, employing the reserve of female labour in the coalmining and manufacturing districts. The movements into both of these marginal areas are more akin to the movements that have taken place within the Region. They are distinct from the distant and largely independent establishments that are characteristic of post-war developments by East Midland firms outside the Region.

The pursuit of the Distribution of Industry Policy is reflected in establishment of suitable types in the problem areas and in the complete absence (with one minor exception) of movement to the prosperous West Midland region and congested area of London. These developments have also eased the critical problem of the shortage of female labour in certain areas of the East Midlands, especially Leicester and Nottingham from which 50% of the new developments have originated. Nearly all the parent firms in these two cities are engaged in textile and clothing manufacture and have found local expansion extremely difficult. The remainder of the parent firms are more dispersed and lie within two principal zones. The first focuses on Northampton and includes adjacent towns where the footwear industry provides the main occupation. The second zone is less clearly differentiated but extends north from Hinckley through Derby and along the Nottinghamshire-Derbyshire coalfield and industrial belt. Here the parent firms are mainly manufacturers of textiles.

The post-war plants established outside the Region by East Midland firms provide employment for nearly 19,000 people of whom 60% are females (Table I). Some 53 parent firms, each employing over 100 persons, have set up 59 factories outside the Region. These range in size from 15 additional employees to over 2,000; 50% of them range between 100 and 400 employees. Virtually all the developments are branch factories and only in a few instances have the parent firms ceased operation in the East Midlands and transferred their factories to other parts of the country.

TABLE I. POST-WAR DEVELOPMENTS IN MANUFACTURING BY
EAST MIDLAND FIRMS OUTSIDE THE REGION.
As at 31st March, 1953*

Region(I) of Destination	Number of Develop- ments	STANDARD INDUSTRIAL CLASSIFICATION (2)										ADDITIONAL LABOUR		
		IV	V	VI	VII	X	XII	XIII	XIV	XV	XVI	Males	Females	Total
Northern	12	-	1	6	1	3	1	-	-	-	-	2,827	2,895	5,722
East and West Ridings ...	12	-	-	-	-	9	3	-	-	-	-	92	1,945	2,037
Eastern	1	-	-	-	-	-	1	-	-	-	-	11	95	106
London and South Eastern	0	-	-	-	-	-	-	-	-	-	-	-	-	-
Southern	1	-	-	-	-	-	1	-	-	-	-	N.A.	N.A.	N.A.
South Western	0	-	-	-	-	-	-	-	-	-	-	-	-	-
Wales	9	-	-	-	-	3	4	-	1	-	1	2,337	2,578	5,215
Midland	6	-	-	-	-	2	4	-	-	-	-	60	391	451
North Western	6	-	-	-	-	1	3	1	-	1	-	550	609	1,159
Scotland	8	1	-	1	-	2	3	1	-	-	-	1,314	2,016	3,330
Northern Ireland ...	4	-	-	-	-	3	-	-	1	-	-	370	442	812
	59	1	1	7	1	23	20	2	2	1	1	7,561	11,271	18,832

* Still in operation at 31st March, 1953; parent firms each employ 100 or more persons.
Source: Board of Trade.

- (1) The Planning Regions cover the following areas: *Northern*: Cumberland, Durham, Northumberland, Westmorland and North Riding of Yorkshire; *East and West Ridings*: East and West Ridings of Yorkshire; *Eastern*: Bedfordshire, Cambridgeshire (including Isle of Ely), Essex, Hertfordshire, Huntingdonshire, Norfolk and Suffolk, except such parts of Essex and Hertfordshire as are within the London and South Eastern Region; *London and South Eastern*: London (administrative county), Middlesex, Kent, Surrey, Sussex and parts of Essex and Hertfordshire; *Southern*: Berkshire, Buckinghamshire, Dorset, Hampshire (including Isle of Wight) and Oxfordshire; *South Western*: Cornwall (including Isles of Scilly), Devon, Gloucestershire, Somerset and Wiltshire; *Wales*: Wales; *Midland*: Herefordshire, Shropshire, Staffordshire, Warwickshire and Worcestershire; *North Western*: Cheshire, Lancashire and High Peak District of Derbyshire; *Scotland*: Scotland; *Northern Ireland*: Northern Ireland.
- (2) The Standard Industrial Classification Orders are as follows: III Treatment of Non-Metalliferous Mining Products other than Coal; IV Chemicals and Allied Trades; V Metal Manufacture; VI Engineering, Shipbuilding and Electrical Goods; VII Vehicles; VIII Metal Goods not elsewhere specified; IX Precision Instruments, Jewellery, etc.; X Textiles; XI Leather, Leather Goods and Fur; XII Clothing; XIII Food, Drink and Tobacco; XIV Manufactures of Wood and Cork; XV Paper and Printing; XVI Other Manufacturing Industries.

MOVEMENTS INTO THE EAST MIDLANDS

The post-war movement of manufacturing into the Region is of a different character from that of the outward movements, while both the number of establishments and the total additional labour involved have been much less. However, an analysis of the location, type and size of establishments shows a definite contribution to the solution of employment problems in particular areas and to the general balance of the structure of regional manufacturing (Fig. 2).

The most striking feature of the distribution pattern is the location of four sizeable establishments in the Grimsby-Immingham district. This concentration is distinguished further by the overwhelming dominance of male labour and by the common type of production, namely, Chemicals and Allied Trades. These developments have provided employment for a large number of redundant workers arising directly or indirectly from the decline in the fishing industry⁽¹⁾. The area has other advantages for large chemical factories notably the availability of port facilities for the import of raw materials and the export of manufactured goods, the accessibility of water supplies from the underlying chalk and the ready disposal in the sea of the large volume of effluent derived from the manufacturing processes.

(1) R. K. Kelsall in collaboration with H. Hamilton, F. A. Wells and K. C. Edwards, "The White Fish Industry", in *Further Studies in Industrial Organization*, edited by M. P. Fogarty, London, 1948, pp. 101-180.

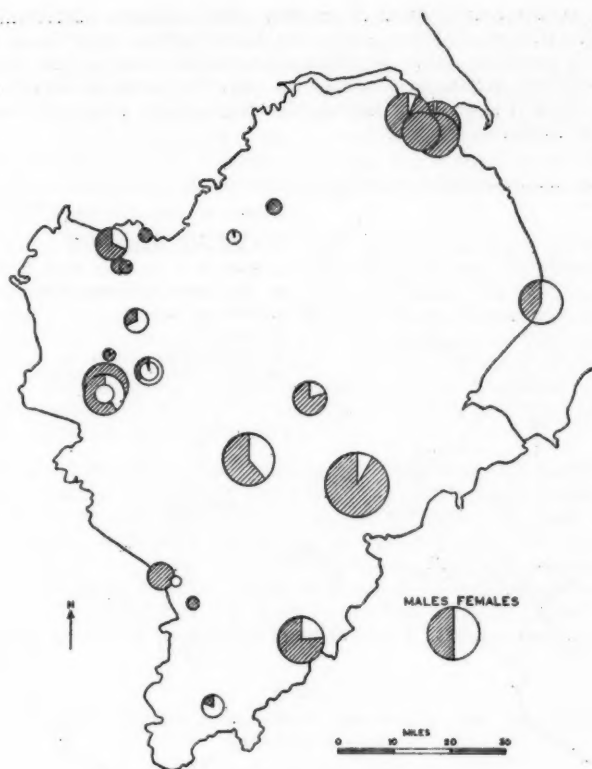


Fig 2

Location and size of post-war developments in manufacturing within the East Midlands by outside firms : as at 31st March, 1953.

A second grouping, more varied in character and dispersed in location, is unified by its association with the Nottinghamshire and Derbyshire coalfield, and the town of Derby itself. Throughout this area the new establishments are generally of small size, although in Derby two are relatively large. The proportions of males and females vary and generalisation as to the type of manufacturing is of little value because of the variety. It should be noted however that textiles and clothing are insignificant.

The chief movements into the rest of the Region are located in the eastern part where five establishments, ranging in size from 200 to 800 employees, have been set up. Each is associated with a relatively isolated centre : Melton Mowbray, Grantham, Wellingborough, Stamford and Skegness. The employment of male labour is typical of the first four ; the fifth, an assembly factory for radio-sets at Skegness, is distinctive on account of the large number of females employed, thus

providing steady employment in an area where seasonal variations due to summer tourist activity along the Lincolnshire coast have long presented a problem. This development however is not of the kind to provide sufficient winter employment to solve the problem fully⁽¹⁾. On the other hand, it is questionable whether there exists a suitable form of industry to fulfil this function.



Fig 3

Location and manufacturing character of outside parent firms with post-war developments within the East Midlands : as at 31st March, 1953. Based on Standard Industrial Classification.

(1) C. Saunders, *Seasonal Variations in Employment*, London, 1936.

The origin of movements into the East Midlands shows a regional pattern of location (Fig. 3). All the parent firms are situated in other areas of England; no other part of Britain having directly contributed to the post-war growth of manufacturing in this region. From within England, there is evidence of a two-fold movement; firstly, distant movement from congested areas in and around London; secondly, movements over a short distance reflecting the attraction of the Region for firms situated in neighbouring industrial centres to the north and north-west.

In the south-east are located nine parent firms most of which are classified into one of two types, either Engineering, Shipbuilding and Electrical Goods, or Chemicals and Allied Trades. In the north, there is a significant concentration on Sheffield and the movements from here into the East Midlands form part of the overspill arising out of the congestion in and around this centre. Somewhat different are the seven parent firms dispersed in an arc, from Crewe to Bradford, along the western margins of the south Pennines and across in to the Textile area of the West Riding of Yorkshire.

Table II based on the Planning Regions shows the breakdown of the movements by type of manufacturing and labour employed. A total of 26 establishments migrating to the East Midlands requires almost 6,000 additional employees of whom 77.4% are males. The units range in size from 30 to 800 employees with 50% employing less than 150 persons. Further, more than one-fifth of the cases represents the complete transfer of a firm and the closure of the parent plant, a considerably higher proportion than is found in the record of outward movement.

TABLE II.
POST-WAR DEVELOPMENTS IN MANUFACTURING WITHIN THE EAST MIDLANDS
BY OUTSIDE FIRMS.

As at 31st March, 1953*

SOURCE REGION (1)	Number of Develop- ments	STANDARD INDUSTRIAL CLASSIFICATION (2)								ADDITIONAL LABOUR		
		IV	VI	VII	VIII	X	XII	XIII	XVI	Males	Females	Total
Northern	1	1	-	-	-	-	-	-	-	558	15	573
East and West Ridings	8	-	1	-	1	2	-	3	1	350	261	611
Eastern	4	3	1	-	-	-	-	-	-	868	300	1,168
London & South Eastern	4	1	2	-	-	-	-	-	1	795	180	975
Southern	2	-	1	-	-	-	-	1	-	1,078	272	1,350
South Western	1	-	1	-	-	-	-	-	-	163	41	204
Wales	0	-	-	-	-	-	-	-	-	-	-	-
Midland	1	-	-	1	-	-	-	-	-	142	-	142
North Western	5	1	-	1	1	1	1	-	-	649	274	923
Scotland	0	-	-	-	-	-	-	-	-	-	-	-
Northern Ireland	0	-	-	-	-	-	-	-	-	-	-	-
	26	6	6	2	2	3	1	4	2	4,603	1,343	5,946

* Still in operation at 31st March, 1953; parent firms each employ 100 or more persons.
Source: Board of Trade.

(1) See Table I, footnote (1).

(2) See Table I, footnote (2).

The balance of movements into and out of the Region emphasises the contribution made by the East Midlands to the attainment of a more balanced distribution of industry over the country (Tables I and II). The comparatively mobile industries of textiles and clothing, which are important elements in the traditional manufacturing structure of the East Midlands, contribute the major share in the movement to other regions. On the other hand, industries entering the Region are of more varied type. It appears, therefore, that the further trend towards industrial diversity resulting from pre-war and wartime developments has been continued in post-war years. Further, the Development Areas, which have received the majority of movements out of the Region, have not been the source for movements into the East Midlands. These facts thus provide clear evidence in support of the effective operation of the Distribution of Industry Policy.

INTRA-REGIONAL DEVELOPMENTS IN MANUFACTURING ⁽¹⁾

The post-war growth of manufacturing within the Region undertaken by East Midland firms includes examples from all the fourteen manufacturing groups of the Standard Industrial Classification. An additional labour force of over 29,000 persons is represented by these developments, with males accounting for 54% of the total (Table III). Arranged in order of employment figures the major developments have occurred in the following groups: Textiles; Engineering, Shipbuilding and Electrical Goods; Clothing; Metal Manufacture. The developments in all manufacturing groups have been examined but only six of the more significant ones are discussed here. In addition it has been found useful to examine separately two sub-Orders (Minimum List Heading). Thus in Textiles the sub-Order of Hosiery and Other Knitted Goods is distinguished from the remainder of the Textile Group, and in the case of Clothing, the sub-Order covering Manufacture of Boots and Shoes receives separate analysis. This treatment is justified, not only because of the large amount of labour required by these two industries, but also because of their particular importance in the East Midlands.

The locational pattern of developments in the Hosiery industry shows a broad correlation with the traditional areas in the west and north-west of the Region (Fig. 4). Elsewhere, there are isolated developments, the most notable of which is at Brigg in north Lincolnshire. Within this pattern there are significant features. Foremost is the marked absence of expansion in and around Nottingham, one of the outstanding centres of hosiery manufacture, while at Leicester a number of small works have been erected. The major concentration is in the industrial districts of the Nottinghamshire and Derbyshire coalfield where hidden reserves of female labour have been successfully tapped. These developments represent an important post-war trend which derived from the war-time voluntary concentration scheme when many factories and much skilled labour were released to other industries ⁽²⁾. The failure of workers, especially those skilled in the trade, to return

(1) In the analysis of intra-Regional developments, the criteria for the inclusion of an extension to existing premises or a new establishment are that the additional labour required totals 10 or more persons and that it is still in operation as at 31st March, 1953.

(2) H. A. Silverman, "The Hosiery Industry", in *Studies in Industrial Organization*, edited by Silverman, London, 1946, pp. 1-46.

to the hosiery industry since the war has created a labour problem which has been intensified by the post-war expansion of the market particularly overseas. This factor, coupled with the shortage of factory space in the traditional hosiery districts, has encouraged a dispersal of the hosiery industry on to the coalfield, a trend which has added substantially to the industrial balance there.

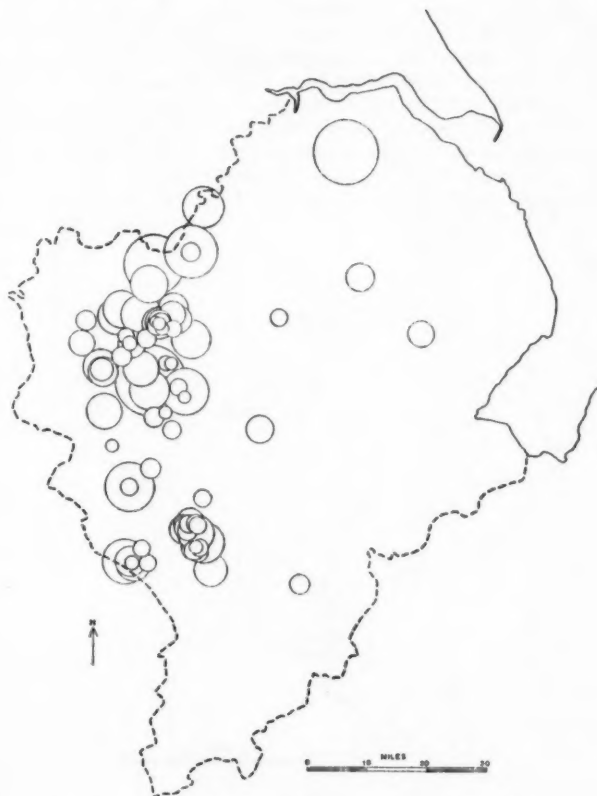


Fig. 4

Location and size of post-war developments in Hosiery and Other Knitted Goods (Order X/118 of Standard Industrial Classification) by East Midland firms within the Region : as at 31st March, 1953.

There are three other features of interest. Firstly, the new units are significant employers of females who represent 78% of the additional labour capacity; secondly, they are characteristically of small or medium size; and thirdly, they are much more important than the additions to all other branches of the textile industry (Table III). The latter show an even higher degree of concentration in the north-west, along the coalfield and in the city of Nottingham. Elsewhere, the only significant development has been at Grimsby-Immingham.

A comparison between developments in footwear manufacture and other forms of clothing shows features similar to that between hosiery and other textiles. Thus boot and shoe making forms a large proportion of all developments in the clothing industry, with female labour predominant.

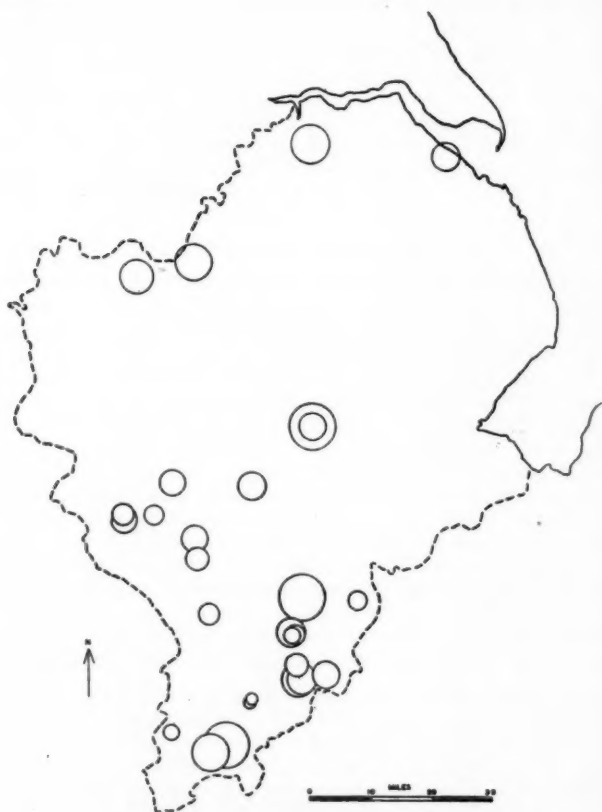


Fig. 5

Location and size of post-war developments in Manufacture of Boots, Shoes, Slippers and Clogs (excluding rubber) (Order XII/148 of Standard Industrial Classification) by East Midland firms within the Region : as at 31st March, 1953.

There has also been some concentration of the post-war growth of footwear manufacture in the traditional areas of production in the southern half of the Region (Fig. 5). These developments are located in two zones—the one extending from Kettering to Towcester and the other from Grantham to Ibstock. Included in each is a major centre of the industry, Northampton, specializing in men's footwear, and Leicester, specializing in women's and children's footwear. In neither town, however, has there been any significant post-war expansion⁽¹⁾. The

(1) H. A. Silverman, "The Boot and Shoe Industry", in *Studies in Industrial Organization*, edited by Silverman, London, 1946, pp. 199-234.

movement is to country towns and villages, reflecting a shortage of female labour in the major centres. This shortage is particularly acute in one section of the industry, that of closing, where the uppers of the shoes are stitched together. It has proved economic to locate small closing factories in numerous small places such as in Woodford Halse near Daventry, and in Little Harrowden near Wellingborough, where the local communities provide a hidden reserve of female labour suitable for this process. In many instances, however, the availability of premises was the immediate problem in opening a branch. The closing factories are examples of specialized units set up near the main factory. In their location, the availability of both labour and buildings and the distance from the factory, appear to be critical factors. There is evidence to support the view that about 30 miles (i.e. an hour's run by car) is a common limit beyond which difficulties of management and communication interfere greatly with the operation of a specialized unit. The small size of the new projects reflects the conditions of the post-war period.



Fig. 6
Location and size of post-war developments in Engineering, Shipbuilding and Electrical Goods (Order VI of Standard Industrial Classification) by East Midland firms within the Region : as at 31st March, 1953.

Developments in the manufacture of other forms of clothing are found scattered throughout the northern half of the Region especially from Coalville northwards through the coalfield. Most are of small size, with a large branch works at Alfreton as a notable exception. Of significance elsewhere are the two tailoring factories at Scunthorpe and Grimsby each being favoured by local reserves of female labour. Both footwear, and the other forms of clothing demand large numbers of women and of the total of 3,600 persons required by the post-war expansion, females represent 86.6% of those absorbed by footwear production, and 93.1% of those entering the other clothing industries (Table III).

A large number of post-war developments have occurred in the broad industrial group comprising Engineering, Shipbuilding and Electrical Goods. Shipbuilding is insignificant in the Region, there being only one small development at Grimsby; on the other hand, expansion in engineering and electrical goods has been substantial. The plants are located throughout the Region and vary considerably in size (Fig. 6); next to clothing, they form the largest employers of additional labour, over 78% being males (Table III).

TABLE III.
ADDITIONAL LABOUR REQUIRED BY POST-WAR DEVELOPMENTS IN
MANUFACTURING BY EAST MIDLAND FIRMS WITHIN THE REGION.
As at 31st March, 1953*

Standard Industrial Classification Order (1)	Total Additional Labour	Males		Females	
		Number	%	Number	%
III	1,722	1,236	71.8	486	28.2
IV	766	649	84.7	117	15.3
V	3,574	3,249	90.9	325	9.1
VI	5,968	4,672	78.3	1,296	21.7
VII (2)	2,589	2,319	89.6	270	10.4
VIII	1,632	495	30.3	1,137	69.7
IX	263	232	88.2	31	11.8
X (3)	2,087	582	27.9	1,505	72.1
X/118(3)	4,985	1,070	21.5	3,915	78.5
XI	87	—	—	87	100.0
XII(4)	2,055	141	6.9	1,914	93.1
XII/148(4)	1,622	218	13.4	1,404	86.6
XIII	1,040	510	49.0	530	51.0
XIV	333	168	50.5	165	49.5
XV	182	114	62.6	68	37.4
XVI	278	109	39.2	169	60.8
	29,183	15,764	54.0	13,419	46.0

* Post-war developments started or completed and still in operation at 31st March, 1953. Those requiring less than ten additional employees are omitted. Source: Board of Trade.

(1) See Table I, footnote (2).

(2) Excluding Motor Repairs and Garages (Order VII/81 of Standard Industrial Classification).

(3) In Textiles (Order X of Standard Industrial Classification), Hosiery and Other Knitted Goods (Order X/118) are excluded and listed separately.

(4) In Clothing (Order XII of Standard Industrial Classification), Manufacture of Boots, Shoes, Slippers and Clogs (excluding rubber) (Order XII/148) are excluded and listed separately. Repair of Boots and Shoes (Order XII/149) are excluded from this Order.

Despite the general dispersion, there is some concentration in the western industrial part of the Region while in the east the chief developments have affected Lincoln, Newark, Peterborough and Grantham. Post-war growth at Grantham is of particular importance for this town seems destined to receive planned movements of industry from the London area. In the west, new development is located in Northampton, in Leicester and Loughborough, in Derby and the lower Erewash valley, in Sutton-in-Ashfield, Mansfield and Chesterfield. In general the new enterprises embrace a wide range of non-electrical engineering manufactures, including machine tools, and account for most of the expansion in the engineering group. In Leicester the making of textile and footwear machinery has grown, as is the case with footwear machinery in Northampton. The production of earthmoving equipment, diesel engines and ball and roller bearings at Lincoln, Grantham and Newark has similarly expanded.

In the category Metal Manufacture the two steel-producing centres of Scunthorpe and Corby have been considerably extended and this is also true of Stanton Ironworks in the Erewash valley.

Some 17,000 persons, of whom 72% are males, are required by the developments in output of Non-Metal Mining Products other than coal (Table III). The distribution pattern shows two concentrations. The first is of medium-size developments along the coalfield where manufactures of bricks and fireclay goods, glass and china and earthenware are typical. The second is along the Trent valley where gravel working forms the basis of concrete products and in the neighbourhood of the valley especially near Nottingham and Newark where gypsum mining has expanded and a large plasterboard mill has been established.

The developments in Food, Drink and Tobacco manufacturing are generally of small size and show a scattered distribution and for these the additional labour required consists of males and females in approximately equal proportions (Table III).

CONCLUSION

With almost 3,400,000 persons in 1951, the East Midlands consisting of 10.8% of the area of England and Wales supported some 7.7% of the total population. In 1950 32% of the Region's insured population of 1,400,000 were females. Within the Regional boundaries are the majority of workers in lace, hosiery and footwear, representing respectively, 64%, 61% and 54% of the total for England and Wales. During the post-war years the East Midlands has made a contribution in the drive for increased production and export ⁽¹⁾ and the foregoing account illustrates some of the features of this trend; but since the analysis is based on employment it is not within the scope of this article to evaluate the changes in production. In many cases, notable increases in output have been achieved through the reorganisation of production, modernization of equipment and increased mechanization, without any reflection in employment figures.

The post-war developments are commonly indicative of the prime importance of labour in a period of full employment. However, in the final choice among various alternative locations, the availability of

(1) See a valuable series of articles by an Industrial Correspondent "Post War Industrial Development (The North Midland Region)", *Board of Trade Journ.*, November 29, December 13, December 27, 1952 and January 3, 1953.

premises has also been a determining factor. As a result of building restrictions many of the developments have made use of a great variety of existing structures. Wartime constructions, ranging from National Fire Service huts to disused aerodrome hangars, have been occupied and brought into productive use along with renovated garages, unoccupied church halls and many other buildings. The exteriors of many buildings in village, town and city give little or no indication of the activities now performed within them while on the other hand many spacious modern buildings and extensions have been erected.

One of the striking successes of the Distribution of Industry Policy as applied to the East Midlands has been the introduction, on a substantial scale, of new industries in the Grimsby-Immingham area. Another is the location of female-employing industries in centres where a hidden labour reserve has been proved. Thus at Worksop and Coalville, the post-war developments have attracted into employment most of the hidden reserves of these coalmining towns. Developments in engineering at Stamford, in hosiery at Oakham and in clothing at Market Harborough are similar examples, while the success of the radio assembly works at Skegness in providing steady employment is noteworthy.

Probably the greatest achievement of the Policy is to be seen in the movements into and out of the Region, for in these developments there is ample evidence of an effective implementation of the Policy. It is not to be expected that all or any of the problem areas have been eliminated. At the same time, there is little doubt that in general the location of post-war developments in the manufacturing industries of the East Midlands has made a substantial contribution towards an improved balance in the industrial structure in both the regional and national interest.

Grateful acknowledgment is due to the late Mr. L. J. Mills of Nottingham, Research Officer in the Board of Trade for the North Midland Region, without whose willing co-operation, prior to his untimely death, this study would have been impossible.

BEACH CHANGES IN LINCOLNSHIRE SINCE THE 1953 STORM SURGE

F. A. BARNES and C. A. M. KING

The storm surge of 31 January—1 February 1953 left many of the beaches of Lindsey in a denuded state, and therefore provided an opportunity of contributing to a fuller understanding of beach changes on this coast by examining their process of recovery. Some conclusions drawn from a group of twenty-three beach profiles⁽¹⁾ surveyed soon after the storm have been presented in an earlier paper⁽²⁾. Most of the lines of profile have been re-surveyed at least five times, most recently in June 1955, and an analysis of the whole series of surveys forms the basis of this paper⁽³⁾.

(1) The term beach profile is used in this paper to designate the surveyed form of the beach along a line perpendicular to the coast on a particular occasion.

(2) F. A. Barnes and C. A. M. King, *The Lincolnshire Coastline and the 1953 Storm Flood, Geography*, Vol. XXXVIII, 141-160.

(3) Lines of profile 7, 9, 11 and 23 have not been relevelled since the first post-storm survey, and therefore are not discussed further in this paper. Profile 16 has been re-surveyed only twice, and is not fully discussed.

THE CHANGING VOLUME OF MOBILE MATERIAL ON THE BEACHES

The amounts of material gained and lost on the different lines of profile since the storm are shown in Figure 1, which indicates approximately the period of most rapid accretion, and the dates at which the beach carried a maximum volume of mobile material. Many variables complicate the analysis of this diagram. For example, the height of the top of the beach varies along the coast, and the varied degree of erosion of dunes during the storm, the cyclical nature of the development and movement of beach ridges, and the construction of new groynes all influence the recorded changes.

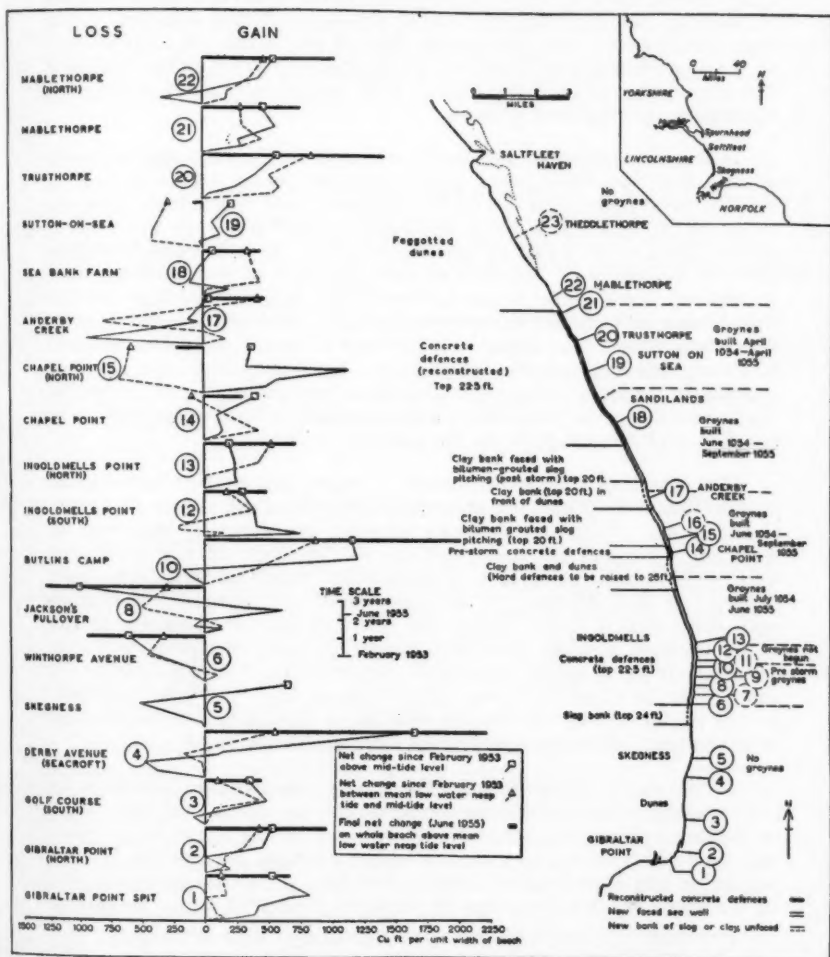


Fig. 1.

Changes in volume of beach material on the lines of profile since February 1953, and coastal defences in 1955

There was a general return of material to the upper parts of the beaches over the period of investigation. By the time of the final survey net gains on the upper beach were recorded on all except two lines of profile. The two exceptions, adjacent lines at Winthorpe Avenue [6] and Jackson's Pullover [8] immediately north of Skegness, are explained by exceptional local circumstances. An initial surplus of sand derived from dune erosion in this vicinity⁽¹⁾ was transferred southwards by the normal processes of longshore drift, while replacement of sand from the north by the same processes was minimised by the effect of the groynes opposite Butlin's Camp. These groynes, the only effective group on the coast before April 1954, intercepted part of the relatively small amount of material moving along the narrow, steep and shingly beaches round Ingoldmells Point. On all the other lines of profile the net gains of sand on the upper beach have been due, in varying proportion, to the landward movement of sand by constructive wave action, and to its southward movement by longshore drifting.

Losses on both upper and lower beaches contributed to the net losses of sand over the whole beach above mean low water neap tide level at Winthorpe Avenue and Jackson's Pullover, but there were also net losses on the beach as a whole at Chapel Point North [15] and Sutton-on-Sea [19] despite gains on the upper beach. In both these instances the loss on the lower beach was probably due to the landward and southward migration of a beach ridge which had formed near the low water mark between the date of the storm and that of the initial survey, which was almost four weeks later at these places. Had it been possible to survey the first profiles immediately after the storm the material composing the ridges would probably have been mainly below low water mark, and net gains would have been recorded on both upper and lower beaches, and consequently on the beach as a whole.

The absolute change of volume of beach material on any line of profile tends to be partly pre-determined by the normal width and height of the beach. Greater volumetric changes are generally recorded on wide sandy beaches like those north of Mablethorpe [22] and north and south of Skegness [10, 8, 6, 4, 2] than where beach material is in short supply. At Mablethorpe [21] and Truethorpe [20], however, there have been considerable gains despite the low and narrow character of the beach because a fairly abundant supply of sand has been available immediately to the north, but a little further south at Sutton-on-Sea [19] and Sea Bank Farm [18] only small changes have yet been recorded. It will be interesting to observe whether a substantial influx of sand from the north will eventually affect this part of the coast.

It is difficult to decide from these data whether the beaches have yet completely recovered from the effects of the storm. On eight lines of profile in June 1955 there was more sand on the upper beach than had been recorded by any of the earlier surveys, but on ten lines a maximum had been reached at an earlier date. A maximum was found on the whole beach on ten lines of profile in June 1955, but a maximum

(1) Near Winthorpe Avenue the natural dunes had been badly mutilated artificially before the storm, for example on the Derbyshire Miners' Home frontage. Here erosion during the storm was excessive, and sand loss from the upper beach has since been continuous.

had been reached earlier on another seven lines. The former category, includes all the profiles north of Anderby Creek except one [17 to 22 except 21]. The continued accretion may be partly due to the effect of the new groyne system completed between April 1954 and June 1955, but these beaches are presumed to be still in process of recovering. By contrast most of the beaches south of Anderby Creek [15, 14, 12, 8, 6, 3, 1] ⁽¹⁾ carried their maximum volume before June 1955, which is taken to indicate their substantial recovery from the effects of the 1953 storm at an earlier date.

These conclusions are necessarily tentative because of the arbitrary distribution of the lines of profile. The number of variables involved detracts from the value of simple generalisations concerning the rates of change of volume of beach material. Nevertheless it is possible to identify several factors as being mainly responsible for variations in the direction and rate of change of volume on individual lines. These factors are discussed below in the examination of specific types of profile.

THE CHANGING FORM OF THE BEACH PROFILES

The relationship between the type of beach and the effect of the storm surge on the coast of Lindsey has been discussed elsewhere⁽²⁾. Beach changes since the storm can also be correlated with the character of the coast, and analysis of the profiles suggests that the following four coastal types should be recognised.

- (a) Sandy beach with ridge and runnel development; normally backed by dunes [1, 2, 3, 4, 5, 6, 8, 17, 22].
- (b) Beach with ridge and runnel development, but with the clay base of the beach exposed in places, usually in the runnels; normally backed by sea walls [14, 15, 18, 19, 20].
- (c) Beach with smooth profile on which the clay base has been exposed [21].
- (d) Beach with a considerable proportion of shingle [10, 12, 13].

In examining the processes operating on these types of beach one of the chief difficulties is the lack of a datum profile at any place on the coast to which individual surveyed profiles at that place may be referred. Where a series of surveys has revealed the form and height of the clay base of the beach the problem does not arise, but where even the lowest surveyed profiles are entirely in mobile material another basis of comparison must be sought. It has been found useful to introduce for this purpose the concept of the sweep zone.

The sweep zone may be defined as that portion of the vertical plane perpendicular to the coastline, within which movement of material may take place under wave action. In this study observations have been mainly limited to the beach exposed at low water neap tide, so that the sweep zone refers only to this part of the beach, although theoretically it will extend to the lower limit of wave action on the sea bed. Its base is formed by a composite profile perpendicular to the coastline,

(1) Profile 5 is omitted because there is an inadequate record of changes on the lower beach.

(2) Barnes and King 1953, *op. cit.*

below which erosion will not take place in the short term : this has been called the lower sweep zone profile. On the upper side the sweep zone is limited by a composite profile, called the upper sweep zone profile, above which deposition does not occur in the short term. These composite profiles are determined graphically by superimposing a number of successive surveys along a given line of profile. The upper and lower points respectively, which on a ridged beach are the ridge crests and runnel bases, are joined by smooth curves. The larger the number of superimposed profiles the more accurate is the representation of the sweep zone, but over long periods changes such as the migration of major offshore banks, which influence the pattern of wave attack, must lead to fundamental changes in the shape of individual sweep zones.

The form of the sweep zone depends partly on the nature of the characteristic beach profile. Where the beach is ridged the sweep zone is likely to be thicker (vertically) than where it is smooth, but a surveyed profile will never lie entirely along the upper sweep zone profile on a ridged beach, although it may do so on a smooth one. Where the solid base of the beach is exposed it forms the effective short-term base of the sweep zone, upon which mobile material moves, but may itself be undergoing erosion as in Lincolnshire. Thus, while the sweep zone concept provides a framework into which cyclical changes on the beach may be fitted, secular changes in the form of the coast would be revealed by changes in the form of the sweep zones over a considerable period of years.

The maximum amount of beach material available for transfer elsewhere from any part of a beach at the time of an individual survey is indicated by the position of the appropriate part of the surveyed profile in its sweep zone. In respect of a whole beach little sand can be exported if the actual profile is low in the sweep zone, but if it is high in the zone a more considerable quantity is available for shifting, the exact amount depending on the thickness of the sweep zone and the character of the beach profile.

Sweep zones for representative beaches of the four types of coast, together with the actual profiles of February 1953 and June 1955 are shown in Figure 2. Where the lower sweep zone profile represents a clay surface this is indicated.

Beach Type A—Gibraltar Point North [2], Winthorpe Avenue [6] and Anderby Creek [17].

The sweep zone of a sandy ridge and runnel beach is characteristically thin towards its landward and seaward limits, and thicker in the middle where ridge development is at a maximum. Profile line 2 exhibits this typical form. The sweep zone, constructed from twelve profiles, half of which were surveyed before the 1953 storm, is attenuated below 0 feet O.D.⁽¹⁾ because offshore sand banks prevent effective wave action and ridge growth below that level. Above 0 feet O.D. beach ridges develop readily, and the sweep zone rapidly thickens to about 5 feet deep. The position of the immediate post-storm profile in the sweep zone shows that although the beach ridges were almost entirely smoothed out by the storm the beach was not seriously denuded. Recovery was therefore rapid.

(1) The Liverpool Ordnance Datum is used throughout this paper.

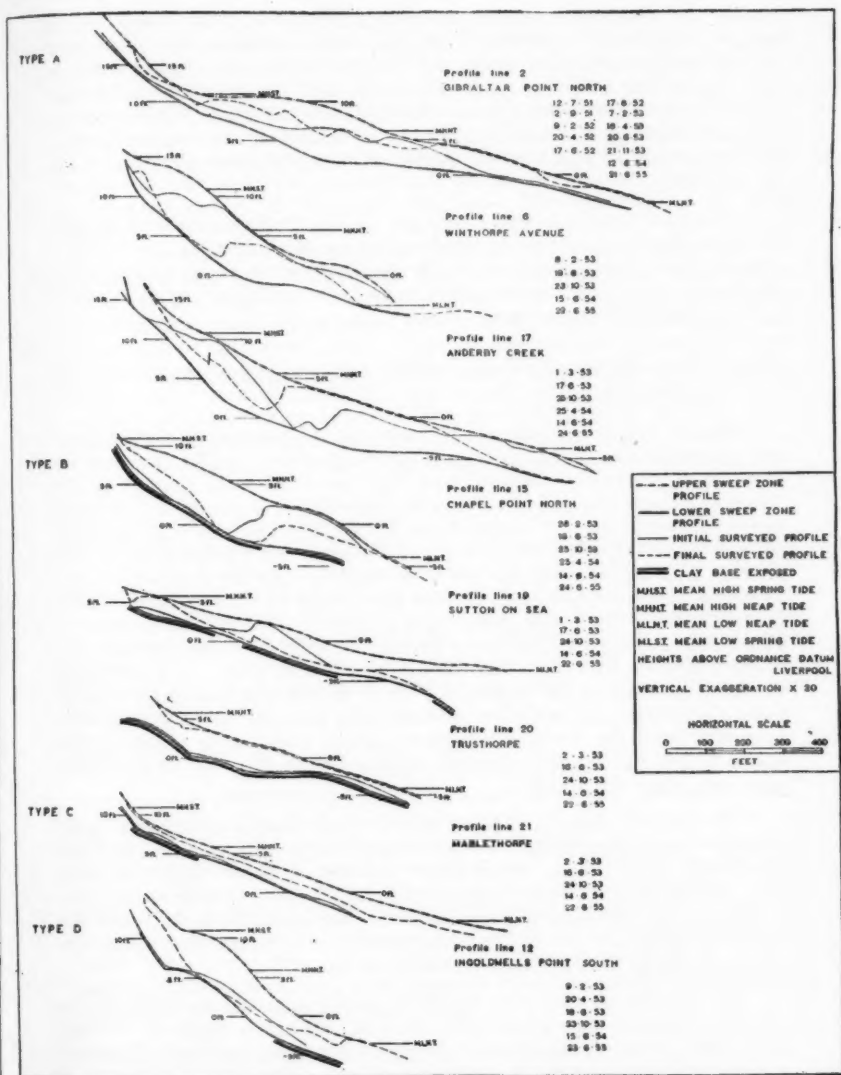


Fig. 2.
Representative sweep zones with initial and final beach profiles.

The same general type of sweep zone is found on profile lines 6 and 17. At Winthorpe Avenue the profile of June 1955 was low in the sweep zone on the upper beach, from which much eroded dune sand had been lost, but a beach ridge was moving landward across the middle of the

beach. At Anderby Creek the seaward attenuation of the sweep zone is marked only below —5 feet O.D., because there is no protection by offshore banks, and constructive waves are therefore active to a lower level on the beach. Initially the upper beach was high due to the deposition of eroded dune sand. Ridge growth lower down the beach has more than compensated for the subsequent loss of sand from the upper beach: the main beach ridge of the summer of 1955 contained a great volume of material.

The first profiles in this group are all high in their sweep zones both because sand was added to the beaches by dune erosion and because the width of the beaches reduced the destructiveness of the storm waves. Since the storm thick sweep zones have been traced out by the growth and migration of large beach ridges.

Beach Type B—Chapel Point North [15], Sutton-on-Sea [19], and Trusthorpe [20].

In this group the clay which forms the foundation of the Lincolnshire beaches is exposed over part of the profiles. The first profiles show that practically all sand had been removed from the top of the beaches, where the surveyed profiles coincide with the effective lower sweep zone profiles. At Chapel Point North [15] clay was exposed down to —1 feet O.D. after the storm, but a large sand ridge had already formed and was moving up the lower beach. By 25 April 1954 the situation had been reversed, in that the profile at the top of the beach coincided with the upper sweep zone profile, while clay was exposed at about —3 feet O.D. on the lower beach. In 1955 clay was exposed over a short section in the middle of the beach and there were moderate amounts of sand on the upper and lower beach, the profile as a whole lying about centrally in the sweep zone. The groynes recently completed here may have the effect of raising the upper sweep zone profile on the upper beach, but cyclical changes of level within this part of the sweep zone are likely to continue.

The sweep zone at Sutton-on-Sea [19] though of similar type, attains a maximum thickness of less than 4 feet compared with the 7 feet at Chapel Point North, where there has been a better supply of sand from the north and where larger beach ridges could therefore be built. At Sutton the clay base was exposed after the storm from the top of the beach down to —4 feet O.D. and even in June 1955 the sand cover was mainly no more than 6 inches to 1 foot thick.

At Trusthorpe [20] clay has been exposed in one or other of the surveyed profiles throughout the width of the beach down to —6 feet O.D. The form of the effective lower sweep zone profile is therefore known, and it is possible to establish fairly accurately the amount of mobile material on the beach. The upper sweep zone profile coincides closely with the profile of June 1955, when sand attained a maximum thickness of 4 feet towards the top of the beach, but lower down varied between 1 and 2 feet in thickness. As at Sutton-on-Sea the sweep zone is fairly thin because ridge development is limited by a shortage of sand.

The form of the clay base which is revealed by this series of profiles is a point of incidental interest. The clay surface tends to be convex on the upper part of the beach, and to flatten on the lower beach, with a

break of slope at about 0 feet O.D. at Trusthorpe [20] and at -2 feet O.D. at Chapel Point North [15]. This profile might be partly explained by the circumstances under which the clay has been eroded by wave action. Before the sea walls which now back these beaches were built, any beach material in front of the sand dunes would tend to remain near the top of the beach, protecting the clay beneath it, while on the lower beach the clay would be eroded to a profile very similar to the lower sweep zone profile of the sandy beaches. The building of sea walls initiated or accentuated a new phase in which material is more readily moved seawards from the upper beach in periods of on-shore winds, and the smaller amounts of sand are liable to be completely removed in severe storms, exposing the convex clay base. This convexity may therefore be a relict feature under present conditions. The deep grooving of the clay in the runnels which develop landward of the beach ridges is perpendicular to the coast, indicating that erosion of the clay is accomplished predominantly by wave action when the beach has been stripped of sand during storms. The possible influence of peat beds, which are more resistant than the clay, in leading to the formation of "structural terraces" on the base of the beach has not yet been fully investigated.

Beach Type C—Mablethorpe [21].

The line of profile at Mablethorpe is anomalous in that it has never shown any indication of ridge development, probably due to the influence of the powerful outfall which intersects it on the lower beach. Its sweep zone is therefore thin. The first post-storm profile, surveyed when clay was exposed on the upper beach, forms the lower sweep zone profile, and the beach built up steadily to a maximum in June 1954. It has since lost material, but the thickness of the sand has never reached 3 feet on the lower beach or 2 feet on the upper beach.

Beach Type D—Ingoldmells Point South [12].

Shingle is not abundant on the Lincolnshire coast, but is more plentiful than usual around Ingoldmells, and the upper and middle beach at Ingoldmells Point South is steep on account of the coarse grade of the material. The upper and lower sweep zone profiles are almost parallel. The initial profile was low in the sweep zone. The upper sweep zone profile traces the path along which the crest of a high shingle ridge, which developed southwards from the outstanding point at Ingoldmells after the storm, gradually moved landwards to merge into the upper beach. This now shows an accretion since the storm of several feet of material, although the two most recently surveyed profiles are considerably below the upper sweep zone profile.

THE RELATIONSHIP BETWEEN LOSS AND GAIN OF MOBILE MATERIAL AND CHANGES IN THE BEACH PROFILE

The discussion of quantitative gains and losses of material along the Lincolnshire coast during the two and a half years since the storm surge (Fig. 1) has been extended by a comparison of initial and final profiles within the sweep zones of representative lines of profile (Fig. 2). The beach changes have been related in general terms to such factors as dune erosion, ridge migration and adequacy of sand supply. These relationships are clarified in Figure 3 by superimposing successive profiles of several representative beaches to illustrate the following types of development produced by wave action under "normal" conditions.

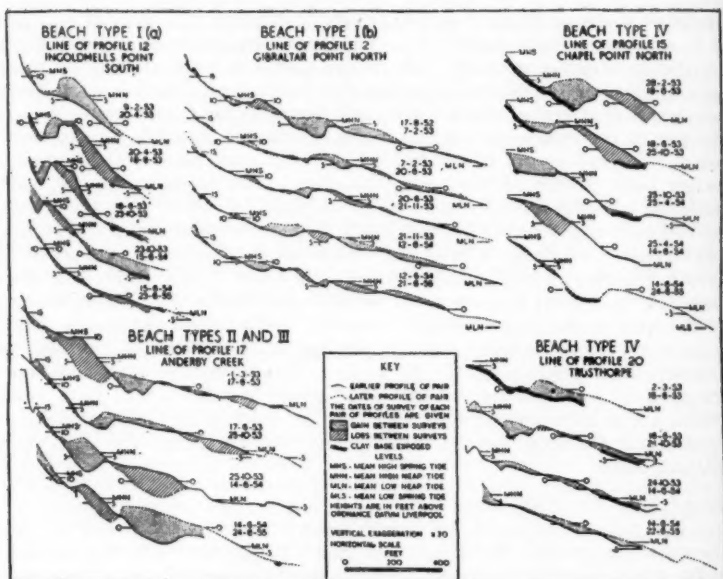


Fig. 3.

Selected groups of successive beach profiles to show changes since the 1953 storm.

- I. Ridge growth in (a) shingle [12] and (b) sand [2].
- II. The removal of a berm produced by dune erosion [17].
- III. Landward and southward ridge movement [17].
- IV. The return of sand over an exposed clay base [15, 20].

At Ingoldmells Point South [12] the large initial gain and subsequent loss of material shown in Figure 1 was due to the growth, landward movement and southward migration of a large shingle ridge. Fig. 3, I (a) illustrates this process. The beach now appears to be nearly in equilibrium, for there was little change between June 1954 and June 1955.

The profiles across the sandy beach at Gibraltar Point North [2] (Fig. 3, I (b)) illustrate the flattening of beach ridges and seaward movement of material under storm conditions, followed by a gradual return of sand to the upper beach by the re-development and landward movement of ridges under normal constructive conditions.

The destruction of the berm built from eroded dune sand at Anderby Creek [17] had been completed by June 1953 (Fig. 3, II and III). The southward movement of the bulk of this sand caused an early gain on the beach at Anderby Creek South [16] (not illustrated), and the gains at Chapel Point North [15] during the first year after the storm were probably derived from the same source (Fig. 3, IV). The Anderby Creek series also illustrates the landward movement of beach ridges as a result of their bodily migration southwards and their slight divergence southwards from the line of the coast. This type of movement, produced by

the combination of landward movement under constructive wave action and longshore drift along the ridge faces, complicates the assessment of gain and loss on individual lines of profile.

Successive profiles surveyed at Chapel Point North [15] and Trusthorpe [20] illustrate the gradual recovery of beaches which were seriously denuded by the storm (Fig. 3 IV). The return of sand over the severely scoured clay base of the beach has again been accomplished mainly by the landward movement of southward migrating ridges originating on the lower beach, and fed partly by sand moving up from below low water mark and drifting southwards alongshore. There was a steady gain of sand for one year at Chapel Point North and for two years at Trusthorpe, but the two lines of profile differ in the amounts of sand returning up the beach and the height of the ridges formed. At first the supply was greater at Chapel Point North, but the ridge which had reached the top of the beach there by April 1954 continued to migrate southwards during the succeeding months, and the level of the upper beach was thereby lowered. In June 1955 another major ridge was moving up the beach. Although the early gains at Trusthorpe, where scouring had been exceptionally severe, were smaller than those at Chapel Point North, there was a considerable final net gain over the whole beach, which was entirely sandy by June 1954. A further general gain of sand was recorded over the following year, possibly helped near the top of the beach by the new groynes.

THE INFLUENCE OF NEW COASTAL WORKS ON BEACH DEVELOPMENT

Coastal defences have been greatly extended since the 1953 storm, and the whole coast between Mablethorpe and Skegness is now protected by a sea wall. This varies in height and design according to local circumstances which include the expected severity of wave attack under normal and storm conditions, the character of the property which is defended by each section of the wall and the condition of the remaining natural defences (Fig. 1). Where the dunes are intact there is usually a clay bank in front of them, faggoted to encourage further accretion of blown sand.

It is not possible at this stage to deduce in detail the likely effects of these structures on beach development, but one significant observation may be mentioned. The sea wall between Chapel Point and Anderby is built in straight sections which intersect at very low angles in almost imperceptible points and embayments. In August 1955 it was noted that the beach was several feet lower round the points than in the embayments, and after a period of onshore winds clay was exposed at the foot of the sea wall at one of the points, which was located at the position of the deepest breach in this sector caused by the 1953 storm (profile line 16) (1).

A groyne system has been under construction since April 1954, and by September 1955 was completed between Mablethorpe and Ingoldmells Point. Although the groynes may have helped towards continued accretion in places their efficacy is as yet unproven. They are designed to raise the level of the top of the beach, and thereby to cushion the dunes and sea walls. Since they do not extend down on to the lower beach they can have no direct influence on the alongshore movement of beach

(1) This observation supports the suggestion made in our earlier paper (1953) that some re-alignment of the defences might be desirable in order to reduce the instability of parts of the coast.

material in that zone. They also appear to have little effect on the movement of major ridges higher up the beach, and are so aligned that they cannot effectively control the seaward and landward oscillation of beach material caused by alternating destructive and constructive wave conditions. Thus, while the groynes may raise the upper sweep zone profile near the top of the beach they are unlikely to eliminate the rise and fall of the level of the upper beach within the limits of the sweep zone, and therefore cannot be relied upon to provide a protective high beach in front of the sea wall at any particular time.

CONCLUSIONS

Many of the beaches of Lindsey appear to have largely recovered from the effects of the 1953 storm, but some beaches are still in process of recovery. Where the beach was sandy, ridged and backed by living dunes the beach profile was not lowered to the lower sweep zone profile by the storm, and recovery was complete before June 1955. Berms formed from eroded dune sand were removed at an early stage. Sand has steadily returned to severely scoured beaches in front of sea walls, but in many cases recovery was still proceeding in June 1955. By that date no clay was exposed above mid-tide level on any of the surveyed lines of profile, and on only two lines was it exposed in runnels above mean low water neap tide mark⁽¹⁾.

Finally, it is important to recognise the limitations of this investigation. Because material moves up and down across low water mark, beach surveys should ideally be extended to the offshore zone some feet below low water level. This might allow some estimation to be made of the proportions of material moving alongshore and up and down the beach respectively, and would therefore clarify the interpretation of such changes as are shown in Figure 1.

Beaches are built and destroyed by wave action, and the local variation of wave action along the Lincolnshire coast is determined largely by offshore relief. Efforts to elucidate the real causes of beach changes in Lincolnshire are therefore limited because the detailed form, height and movement of the offshore banks are unknown. It is many years since the coastal waters of Lincolnshire were accurately surveyed, and in the interim notable changes have taken place in the pattern of erosion and accretion. The Waverley Committee, stressing in its Report the national urgency of fundamental research into beach development and the movement of offshore sand banks, rightly implied the very close connection between these two problems⁽²⁾. Until an offshore survey has been made this type of study cannot be carried to its ultimate conclusion.

(1) This conclusion must be qualified by stressing that it refers only to the vicinity of the beach profiles, and that clay was still exposed fairly high on the beach, for example in front of the new sea wall on the Huttoft frontage north of Anderby Creek.

It must be noted that the term 'recovery', as used here, does not refer to a re-establishment of the pre-storm conditions, which were unrecorded except south of Skegness. The criterion of recovery has been taken to be a cessation of accumulation of material on the beach as a whole above low water neap tide mark in the period of investigation. No direct comparison is possible between the 'normal' condition of the beaches before and after the storm because of the probable influence of the new coastal defence works.

(2) *Report of the Departmental Committee on Coastal Flooding*, Cmd. 9165, H.M.S.O., London, 1954, Para. 114, p. 28, Recomm. 3, "That it is particularly important to stress the urgency of research into the movements of beach material, offshore sand banks and related coastal problems; but that in the meantime full use should be made of groynes where they are likely to be effective as a means of retaining beaches".

THE 1951 CENSUS: (3) AN ANALYSIS OF POPULATION CHANGES IN NOTTINGHAMSHIRE

A. G. POWELL

Widespread and substantial increases of population throughout Nottinghamshire between 1931 and 1951 reflect the development of mineral and agricultural resources and the expansion of a wide range of manufacturing industries and professions in a prosperous Midland county. The variety of both its natural resources and its industries together with its position in relation to major north-south lines of communication give Nottinghamshire the most "balanced" economy of any East Midland county. The 1951 census reveals its general prosperity in higher rates of population increase, both in absolute and relative terms, than those of any of its neighbours.

TOTAL CHANGES WITHIN THE COUNTY

In 1951 the population of the geographical county of Nottinghamshire was 128,480 or 18% higher than it had been at the previous census in 1931. It had grown at an average annual rate of 0.9%, which is twice the comparable rate of 0.45% for England and Wales as a whole. Owing mainly to the general fall in the rate of natural increase, the average growth is below that of the preceding decade when the increase amounted to 71,582 or 11.2%. The spread of the increase throughout the past twenty years has been much more uniform than that in Derbyshire or Leicestershire, as examined in previous issues of "The East Midland Geographer". Between 1931 and 1939, Nottinghamshire recorded a growth of 6.2% (0.77% per annum) while between 1939 and 1951 it rose by 11.1% (0.93% per annum). Almost all of the rates of increase quoted are approximately twice the national averages. Again unlike the situation existing in Derbyshire and Leicestershire, the rate of increase of population has been fairly uniform throughout the regional sub-divisions of the county (see Table I). Only in the predominantly agricultural parishes of the Trent Valley does the general increase fall below the national average. Elsewhere the expansion of production on the Coalfield, industrial expansion in the vicinity of Nottingham and widespread industrial, mineral, airfield and dormitory developments over the eastern parts of the county have caused population increases varying from 12 to 25 per cent since 1931. The greatest absolute and relative increase occurs in the south-eastern quadrant of the county where the Greater Nottingham Region combines with adjacent parts of Derbyshire and Leicestershire to form an urbanised block throughout which population has increased by more than 20% since 1931⁽¹⁾.

In common with other parts of the Midlands, Nottinghamshire shows a fall in the average size of family from 3.8 persons in 1931 down to the national average level of 3.2 in 1951. The total population increase of 18% conceals an increase of no less than 37% (67,528) in the

(1) See related articles in *The East Midland Geographer*, December, 1954 and June, 1955 and R. H. Osborne: "Population concentrations and Conurban tendencies in the Middle Trent Counties", *E.M.G.*, December, 1954.

number of "private households" or families. The number of "structurally separate dwellings", in spite of pre-war slum clearance and post-war building problems, had increased in sympathy with the multiplication of separate families (by over 61,000 or 34%) (1). It is of interest to note that during this inter-censal period the increase in numbers of families and houses in the East Midlands is commonly double the rate of increase of total population and that, therefore, the very substantial expansion of population in these generally prosperous counties is exaggerated when it is reflected in the spread of settlements in the landscape. This must be a matter of special concern to the planners of the landscape, particularly in those Middle Trent areas in which conurban tendencies are strong.

NATURAL CHANGE

The total increase of 18% in the population is made up of a 12.3% growth arising from a balance of births over deaths during the period, i.e. to natural increase, and a balance of 5.7% which for all practical purposes can be taken as net immigration into the county. A north-south line from Bawtry to Upper Broughton divides Nottinghamshire almost equally into an industrial and urban west and an east which still remains predominantly rural. The same clear cut division is revealed between the relative rates of natural increase in the western and eastern county districts. Virtually the whole of the western half of the county has a natural increase above the county average while the eastern half is uniformly below average. In the west, only Nottingham, Mansfield and West Bridgford record low rates. Nottingham (9.6%) and Mansfield (11.9%) are the older cores of the two main urban concentrations in the county from which considerable numbers of young persons have moved in recent years to give high rates of natural increase in neighbouring suburbs. In the case of West Bridgford, the very character of the urban district is reflected in the exceptionally low figure of a 0.2% natural increase (representing less than forty more births than deaths during the whole twenty year period). West Bridgford is a dormitory suburb for a predominantly middle-aged population and has been especially attractive to members of the "Professional and Intermediate" Social groupings (see Table 27 of the Census Report). 38% of the population of West Bridgford falls into these two classes compared with an average of 19.5% in Nottingham and its five adjoining urban districts and of only 14% in the county as a whole.

The highest rates of natural increase occur in those districts into which a young population has been migrating in consequence of new industrial or suburban development. Worksop Rural District has the highest rate in the county (24.6%) arising from the influx of miners to the developing collieries at Harworth, Firbeck and Manton. Mansfield Woodhouse (21.6%) and Warsop (20.3%) also record high rates related to the expansion of coalmining in the immediate vicinity. Although the average rate in Southwell Rural District (15.4%) is lower, there can be little doubt that most of the natural increase is concentrated into the western half of the district where a new coalmining economy is being superimposed upon the older agricultural and forest landscape (at Clipstone, Blidworth, Edwinstowe, Ollerton and Bilsthorpe) and that

(1) The number of families living two or more to a dwelling was 8,960 in 1951, i.e. over twice the corresponding number in 1931.

the undisturbed farming parishes to the east conform to the pattern of low rates of natural growth generally characteristic of east Nottinghamshire. As will be seen later, most of these coalfield districts also have high rates of emigration which commonly leave only a relatively small net increase of population since 1931. With the exception of West Bridgford, all the suburban districts around Nottingham show rates of natural increase well above the county average and among them Beeston and Stapleford is outstanding. Its natural increase of 23.3% is related to the marked expansion of industry in the valleys of the Trent and Erewash and to residential development associated with both the local industrial expansion and that of the Nottingham area generally.

Over the eastern half of the county natural increase rates are low, especially in the agricultural rural districts, e.g. Bingham (5.6%) and Retford (4.9%), though they are somewhat higher in the towns, notably in Newark and the surrounding parts of Newark Rural District, both of which have been affected by industrial expansion.

MIGRATION

The general pattern of migration movements in the county is almost the reverse of that of natural increase. In broad terms all the districts south and east of the Trent, including however the whole of Greater Nottingham, have increased by immigration whilst those north of the river are characterised either by emigration or rates of immigration well below the county average (5.7%). In the south western part of the county the belts of substantial natural increase and of substantial immigration overlap to produce the high figures of net increase in Greater Nottingham and the surrounding rural areas towards the borders of Derbyshire and Leicestershire. The geographical distribution of the migration trends emphasises a broad area of immigration centred on Nottingham and one of emigration covering the coalfield.

The expanding industrial, administrative and educational functions of Nottingham have clearly been the main magnets attracting population to the south-west of the county. The detailed picture shows that, while Nottingham itself had a very small inward movement (1.2% or 3,300 persons) partly due to a lack of available building sites, the surrounding suburban districts record some of the most spectacular increases in the East Midlands. An immigration of 56%, representing some 15,500 persons, into Beeston and Stapleford Urban District is the highest in the county and consists of new residential population working in the new factories in the Trent and Erewash Valleys, new suburban population working in Nottingham industries and a considerable part of the growing numbers of staff and students of Nottingham University which lies immediately across the Nottingham city boundary. West Bridgford with an immigration of 29% (5,600) and Arnold (34% or 4,750) have expanded primarily as residential dormitories during the period. Immigration into Carlton (17% or 4,400) and Hucknall (11% or 2,000) is in part due to dormitory development and in part to a limited amount of industrial growth: in these areas relatively steep slopes or a mining environment have acted as checks on housing expansion as compared with more favoured districts to the south and west of the city.

The development of dormitory villages in the Rural Districts of Bingham and Basford which surround the urban core of Greater Nottingham are reflected in substantial immigration into both areas. Examination of parish trends shows that this growth is concentrated mainly into villages within ten miles of the city centre and mainly to the south of the Trent. Thus Basford Rural District with a net immigration of 3,800 persons, although showing marked increases in its northern parishes adjacent to the city at Trowell and Nuthall, shows a greater expansion south of the river at Ruddington, Bunny and East Leake where rural surroundings are brought into close proximity to the industrial city by means of suburban rail and bus facilities. In Bingham Rural District an immigration of some 4,700 persons is concentrated mainly into the dormitory villages of Radcliffe-on-Trent, Keyworth, Stanton-on-the-Wolds and Tollerton. Since 1931, Tollerton has grown from a small country village of 127 persons to a dormitory estate with a population of 893 entirely in response to the development of private building estates in an attractive rural setting within a twenty minute bus journey from the city centre. The post-1951 growth of the new city housing estate at Clifton is a continuation of the southward trend but is, of course, not recorded in the current census. Immigration into both Basford and Bingham Rural Districts is not entirely associated with the expansion of Nottingham; coalfield developments north of the city and new mineral and industrial projects to the south have also caused an influx of population. East Leake, for example, has experienced a net growth of over 80% partly in consequence of developments in the local mining and manufacture of gypsum, partly as a dormitory for Nottingham and partly as a dormitory for Loughborough, this last being symptomatic of the conurban tendencies prevailing in the Middle Trent area as a whole.

A general trend of outward migration is characteristic of the Coalfield districts. Only in Mansfield Woodhouse (+8.3%) is any marked immigration recorded and, although this is primarily associated with new colliery developments in the vicinity it is also in part a local "overspill" of population from Mansfield to new houses in relatively more attractive surroundings. As elsewhere in the East Midland Coalfield, high rates of emigration from the colliery districts are a reflection of the comparatively high rates of natural increase combined with an absence of employment other than that offered in the mines or on the land. In those Coalfield towns where more varied industry is available the rates of emigration are at a minimum e.g. 0.5% emigration in Mansfield and even a very small immigration (0.3%) into Worksop. At Warsop on the other hand, where there is virtually no employment except in the local collieries, the Urban District shows a slight fall in population since 1931; one of the highest rates of natural increase in the county has been more than offset here by an even higher rate of emigration (21%). Throughout the Nottinghamshire Coalfield outward migration rates of six or seven per cent. are common but, being areas of substantial natural increase, there is a tendency for the net change to be one of modest increase in population. There can be no real doubt that the proximity of the expanding industrial magnet of Greater Nottingham to the areas of limited industrial opportunity on the Coalfield have caused a strong flow of population from the Coalfield districts to the urban industries. This movement was of particular significance in the pre-war period when depression affected the colliery districts to a much greater extent than most of the Nottingham industries.

In the agricultural areas of central and eastern Nottinghamshire isolated mineral, industrial and wartime developments have contributed to a modest rate of immigration into the areas around Retford and, more particularly, Newark.

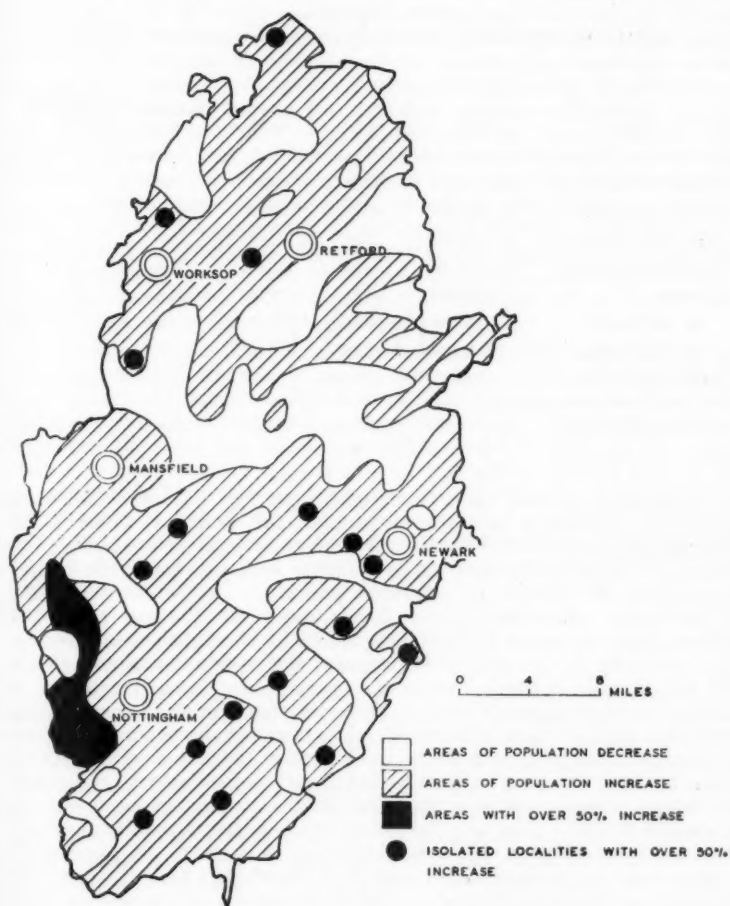


Fig. 1.
Nottinghamshire, population changes 1931-51.

NET CHANGE

The pattern of net changes resulting from natural increase and migration trends, as plotted from the detailed parish statistics, is shown in Fig. 1 and summarised by sub-regions (also see Fig. 2) in the following table.

NOTTINGHAMSHIRE :
ACTUAL AND PERCENTAGE CHANGES OF POPULATION 1931-51 BY REGIONS

Region	1931	1951	Actual Increase	Percentage Increase	1951 Population as percentage of county total
Vale of Belvoir	33,912	42,249	8,337	24.6	5.0
Greater Nottingham	395,484	480,743	85,259	21.6	57.2
South Notts. Wolds	6,985	8,030	1,045	15.1	1.0
Mid-Notts. Keuper Belt	39,132	44,733	5,601	14.3	5.3
Coalfield	220,946	248,714	27,768	12.5	29.6
(a) Old Coalfield	(160,200)	(178,167)	(17,967)	(11.2)	—
(b) New Coalfield	(60,746)	(70,547)	(9,801)	(16.1)	—
Trent Valley	16,272	16,742	470	2.9	1.9
NOTTINGHAMSHIRE	712,731	841,211	128,480	18.0	100.0

The most obvious feature emerging from Fig. 1 is the widespread nature of population increase throughout the county. There is no immediately obvious correlation with urban spheres of influence as in Leicestershire or Derbyshire nor is the main road pattern of the county emphasised by ribbons of increased population as in Leicestershire. Undoubtedly urbanisation and development along main roads are factors quite as potent in Nottinghamshire as in neighbouring counties but, especially in the west of the county, the number of towns is such and the network of class A roads is so close that an amorphous area of population increase must result. Moreover throughout the county the number of isolated developments which have given rise to local increases of population of 50% or more is much greater than in Derbyshire and Leicestershire. In many cases these are depots and industries established in wartime whose occupation for either civilian or military use persisted at least until 1951. They are but one example of the effect of the housing shortage prevailing in 1951 in presenting a pattern of population increase over areas more widespread than would have been the case had building conditions facilitated as free a movement of population after the war as was possible before it.

The widespread nature of population increase throughout the county is shown by a comparison of increases in and near towns with those in rural areas. If the urban areas of Nottinghamshire are defined arbitrarily as those within eight miles of the centre of Nottingham and within five miles of the centres of Newark, Mansfield, Retford and Worksop, then the urban population increased by 18.5%. The balance of increase in the remaining rural areas still reaches the surprisingly high figure of 12.8%.

In an area of such general increase, substantial zones of decreasing population are of more than usual interest. One such zone occurs in Nottinghamshire in a belt four to five miles in width extending from Warsop in the west to Besthorpe in the east. It comprises twenty-three parishes whose joint population in 1951 was 1,172 lower than in 1931; a fall of 4.8%. The belt is crossed by five "A" class roads and includes a number of the relatively new colliery villages and the Eakring Oilfield in addition to the more remote agricultural communities in the centre of the county and the Trent Valley. It appears to be an anomaly in the pattern of population change. Whilst explanations can be adduced to explain the detailed changes, the overriding general explanation appears to be that this is the area of Nottinghamshire most remote from the full range of urban influences. Ollerton, at the centre of the belt is more than eight miles distant from either Mansfield, Worksop, Newark or Retford; road journeys of ten or twelve miles are necessary to reach any of these towns. The trends shown in the census in this area support the need for a new urban centre in this part of the county. Ollerton is, in fact, proposed for expansion in the Written Analysis of the Nottinghamshire Development Plan in response to the expansion of mining activities in the area and to its excellent road communications.

Elsewhere in the county, population has decreased significantly in those agricultural areas most remote from main road communications, notably between Retford and Newark and Newark and Nottingham. There are also broken belts of decrease or low rates of increase defining the outer limits of the immediate spheres of influence of the urban groups as, for example, between Greater Nottingham and Newark or Mansfield (a belt which, as previous articles have shown, is continued in Derbyshire and Leicestershire). The central belt of decline mentioned above and isolated extensions to the north and south of it also separate Newark and Mansfield from Worksop and Retford and, to a lesser degree, from each other.

REGIONAL CHANGES

1. *Greater Nottingham.*

During the period under review, Nottingham has been one of the most prosperous industrial centres in Britain. It was affected but little by the depression of the early thirties which coincided with the expansion in Nottingham of several of the consumer goods industries which have now become the largest employing units in the area. In the main industrial belt of the Trent Valley, large expansions took place westwards into Beeston and Chilwell and eastwards into Colwick and Netherfield. At the same time factory extensions and new light industrial estates have consolidated earlier development in the Leen Valley into what is virtually a continuous industrial belt extending northwards from Lenton to Hucknall. Further west beyond the county boundary but still influencing the settlement pattern in Greater Nottingham, a marked expansion running parallel to that in the Leen Valley took place in the Erewash Valley between Long Eaton and Ilkeston (1). Other small industrial areas were sited in the new housing estates between the Leen and Erewash valleys. Since the war the location of large new industries in Nottingham has been contrary to government policy on location of industry. A number of the largest employers have built new factories in

(1) See *E.M.G.*, December, 1954, p. 19.

the Development Areas, whilst others, especially in the clothing group, have established branch units in the Coalfield areas from which many women had previously travelled long distances to work in Nottingham. In spite of these developments, which if sited in Nottingham would have caused an even greater influx of population, the expansion of firms within the Greater Nottingham area has proceeded more rapidly than in any other part of the East Midlands other than such favoured localities as Scunthorpe, Corby and the Humber Bank of north Lincolnshire where special physical advantages have been exploited. Unemployment has remained at an insignificant level (commonly at half the national rate) and an acute shortage of labour prevails, some five or six vacancies being available for every person unemployed at a given time. The expansion of employment in the service and professional trades is at least of equal importance in explaining the rate of growth of population. Additional responsibilities for county and county borough authorities and the establishment of Nottingham as the regional centre of the standard North Midlands Region have caused a big influx of local and central government officials. The regional function of Nottingham has been further emphasised by the development of its University College to University status and by the expansion of its Technical and Art Colleges. Numbers of staff and students in each of these institutions are between two and three times higher than in 1931. The growth of the city in response to improved road transport facilities and decentralisation of responsibilities by many national concerns has caused an influx of regional headquarters organisations and professional bodies and there has been a continuous expansion of shopping facilities designed to serve both local and regional populations. Quantitative assessment of this growth is not readily obtainable but Table 27 of the census report shows that one in every six men living in Nottingham and the adjacent urban districts is in the "Professional and Intermediate" classes.

The Greater Nottingham region has been defined in Fig. 2 to include all contiguous urban development and the innermost dormitory villages in which growth has been most marked. Within this area, which covers about one-tenth of the county, over 57% of its population is concentrated. With the exception of population decreases to be expected in the central wards of the city and those in certain marginal parishes which indicate the limits of the region, substantial increases are general. The main growth of population has however been concentrated on the western flanks of the city, where in a narrow belt extending northwards from Beeston through the western wards of the city to Trowell and Nuthall the population has increased by 65,600 to a total 84% above that in 1931. Within this belt, Beeston and Stapleford Urban District grew by more than 22,000 persons (79%) to create since 1931 an effective and complete urban link between Nottingham and the Erewash Valley towns of Long Eaton and Sandiacre. To the north, new urban links are being formed through Trowell (which grew by over 250%, i.e. by 1,100 persons) between Stapleford and Ilkeston on the one hand and between the new western suburbs of Nottingham and Ilkeston on the other. Still further north, a further link has been completed by the expansion of Nuthall (122% or 1,100) between Nottingham and the Erewash Valley towns of Kimberley and Eastwood. Between these two northern links a small belt of population decrease in the parishes of Strelley, Awsworth and Kimberley marks the division between Greater Nottingham and the Erewash Coalfield towns.

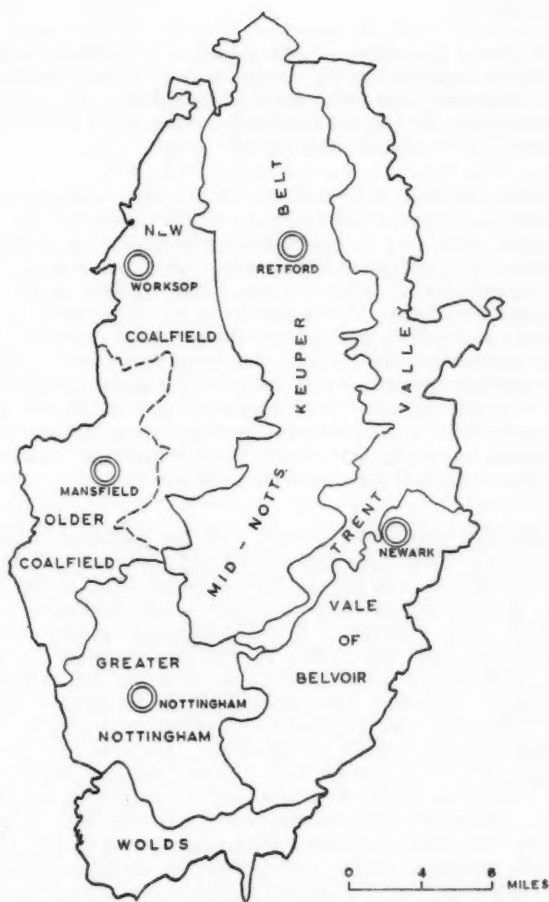


Fig. 2.

Nottinghamshire, Regional Divisions defined by parish boundaries.

To the north, south and east of the city earlier links with suburban development at Arnold, Carlton, Hucknall and West Bridgford have been consolidated by further substantial increases while, under the influence of improved road services, private building has accelerated dormitory development in most of the surrounding rural villages, notably at Burton Joyce, Radcliffe-on-Trent, Ruddington, Tollerton and Keyworth. Coalmining activities have tended to create conditions north of the city which are not conducive to a marked growth of population.

2. *The Coalfield.*

The eastern boundary of the Coalfield is drawn to include all parishes having collieries in full operation in 1951 but excludes those in which new collieries were being sunk at that date. Almost 30% of the county population lives on the Coalfield leaving only 13% living outside this and the Greater Nottingham region.

Attention has already been drawn to the high rates of both natural increase and emigration which characterise the Coalfield. The net result is an increase of 12.5% in the region, which although substantial in actual numbers (28,000) is below the county average—though this latter is of course heavily weighted by the high increase rate in Greater Nottingham. The Coalfield is frequently sub-divided by the geographer into its newer and older parts and the division used in Fig. 2 is broadly according to whether the collieries were opened before or after 1900. However marked may be the differences in the landscape between these two sub-divisions, differences in population growth are not as great as might be expected (see Table I) though the newer colliery villages in the central and northern parts of the county naturally produce higher rates of increase than is the case to the west.

The detailed pattern of change over the Coalfield indicates that urbanisation is a trend affecting mining populations quite as much as other elements in the rural population. The Coalfield is all too commonly considered in terms of the isolated village in the shadow of the colliery winding gear. Fig. 1 indicates that the increases of population in the older part of the field are closely related to the urban group around Mansfield, whilst in the newer coalfield the increases are focussed mainly upon Worksop. In spite of the building of "model villages" near many of the new collieries, the resulting communities of 3—5,000 population do not appear to be wholly satisfactory. Each of the new colliery parishes of Ollerton, Clipstone and Rufford has lost population since 1931. The situation cannot be adequately explained by the emigration of the large numbers of children who must inevitably have formed a high proportion of the young population which had settled in the villages only in the middle twenties. In the post-war period the East Midland miner, supported by his improved economic status, shows signs of preferring to live in or near the town with its greater opportunities for shopping and entertainment and for the education and employment of his family. Surveys made in 1948 of the daily journeys to work of miners show large outward movements over considerable distances to collieries in both Derbyshire and Nottinghamshire from the belt of towns extending from Nottingham and Hucknall northwards through Kirkby, Sutton, Mansfield and Warsop to Worksop. One of the most important functions of these towns is to act as miners' dormitories.

The isolated localities within the Coalfield region which show marked increases of population (Fig. 1) with the exception of Carlton-in-Lindrick, which has expanded as a dormitory for both Worksop and the new Firbeck colliery, are related to the continued civilian occupation in 1951 of wartime camps. In many cases the increases in population are likely to prove transitory.

3. *The Vale of Belvoir.*

The region defined in Fig. 2 covers the drainage basin of the River Devon and its tributaries the Smite, Car Dike and Black Dike rather than the Lias Clay lowlands on the Lincolnshire border to which the name is more commonly applied. The bluff forming the eastern boundary of the Trent acts as a barrier which causes the parishes immediately east of the river between Greater Nottingham and Newark to look further eastwards and establish their social contacts either with the old market village of Bingham or the more important industrialised market town of Newark. The Vale of Belvoir is a region typifying the factors affecting population change in Nottinghamshire since 1931. On average, it has increased its population by almost 25% (the highest proportionate increase of any region in the county) but the overall figure disguises a patchwork of highly localised increases and decreases ranging from the fourfold expansion of Flintham to the 32% fall at Cotham only five miles away. The level plain of the Keuper Marl and the low platform of the Hydraulic Limestone in the Liassic series which flanks the Smite Valley to the east provide ideal conditions for the new airfields which have been developed at Newton (Shelford), Syerston and Langar. Exploitation of the minerals associated with the same rocks is responsible for the population increases at Cropwell Bishop, Staunton and Kilvington (gypsum mining and manufacture) and again at Barnstone (cement). At Hawton and Cotham, where large areas are held or are being quarried for gypsum, mineral working has led to a fall in population. Industrialisation and urban development around the old established market town is illustrated at Newark where the engineering industry in particular has expanded and population has risen by 17% (2,382 persons) in the town and by 55% (2,137 persons) in the neighbouring suburban parishes of Farndon, Balderton and Coddington. The southern part of this region also includes a sector of the outer ring of Nottingham dormitory villages. The modest growth of Bingham, East Bridgford, Cotgrave and Kinoulton is related primarily to dormitory settlement in areas with good road access to the city. In the damp, low-lying pasture land of the Smite-Devon Valley, substantial decreases are common particularly where road access is inferior.

4. *The South Notts. Wolds.*

This small region occupies the moderately undulating clay country continuing from Leicestershire into South Nottinghamshire. In so far as population is concerned it forms a transition zone between Greater Nottingham and the Lower Soar region of Leicestershire. Increases of a low order with some actual decreases characterise the parishes immediately south of the Greater Nottingham region but further south still a belt of parishes along the county boundary from Nurmanton-on-Soar to Thorpe-in-the-Glebe reflects the proximity of Loughborough. Within this transition zone, the extensive mining and manufacture of gypsum in the parishes of Thrumpton, Gotham and particularly East Leake give rise to population increases and produce an individuality of landscape justifying recognition of this as an independent region.

5. *The Trent Valley.*

The long narrow belt along the Trent from Greater Nottingham to the northern boundary of the county has a well marked physical and economic unity imposed by the river valley and the common occupations

(e.g. cattle fattening and gravel working) related to it. It has little or no cohesion as a social or population region; main roads cross rather than follow the river and population changes tend to fall into a number of compartments influenced by circumstances beyond the valley itself. Unity is given only by the small degree of overall change, i.e. an increase of 2.9% or one-sixth of the average rate for the county which gives marked emphasis to its relative isolation. The southernmost parishes are part of the outer ring of Nottingham dormitories continuing from the Vale of Belvoir. Similar dormitory development strengthened by the influence of the Great North Road occurs in the parishes lying to the immediate west of Newark where further slight population increases are also associated with the new but almost automatic electricity generating station at Staythorpe. North of Newark the east bank parishes maintain a prosperity through the specialised cash crops grown on their light soils in relation to readily accessible markets at Lincoln and Newark. Increases here emphasise the declines experienced in the parishes isolated from these local markets on the west bank of the river. Some parishes, especially where large scale gravel workings are in progress, have lost population; indeed the parish of Meering which had a population of six in 1931 has now lost it all. On the west bank of the river below Newark the parishes occupy long strips running westwards from the river on to the Keuper farmlands beyond and the alternation of increases and decreases of a relatively low order from parish to parish emphasises this as one of the most remote corners of the entire county. Localised increases occur at main road crossings e.g. at Ragnall with a 13% increase, and where special circumstances arise as in the expansion of the Rampton mental institution which leads to increases in both Rampton (7%) and Treswell (20%). Dormitory influences together with local industry and main road access lead to a final pocket in the parishes west of Gainsborough all of which show modest increases with the exception of West Stockwith whose declining associations with the Trent waterway are reflected in a fall in population of 30%.

6. *The Mid-Notts. Keuper Belt.*

The large agricultural area forming the spine of the county is broadly coincident with that part of the Keuper outcrop lying west of the Trent though it does include a broken and sparsely populated fringe of Bunter Sandstone on the extreme west. Within this region population changes fall into five groups.

In the vicinity of Greater Nottingham and in an area extending to the north of Southwell substantial increases prevail. They arise from two basic factors. Firstly, this is a further continuation of the outer ring of dormitory villages associated with Nottingham but secondly the dormitory developments are superimposed upon a prosperous market garden economy developed upon the lighter soils of the Keuper Sandstones and expanded since 1931 in sympathy with the much increased market available in the Middle Trent area as a whole. Both factors operate in explanation of the population increases at Lambley, Woodborough, Lowdham, Thurgarton, Southwell and Halam, all of which are important areas for the production of vegetables, small fruits, flowers and apples as well as being dormitory villages for Nottingham workers. In the remainder of this southern area, as indeed throughout the whole

belt, there has been a swing since 1931 towards intensified arable farming as well as milk production and population has not fallen materially. The isolated pockets of decrease which do occur arise from purely local circumstances such as the by-passing of Gonalston to leave it as a rural backwater off the main road, the closing of country houses and dispersal of their staffs (Epperstone and Edingly) or the amalgamation of farms on an industrial scale with a corresponding reduction of labour (as at Halloughton).

This southern group of parishes, most of which focus on the small cathedral and shopping centre of Southwell, is succeeded to the north by the main belt of decrease across the county to which attention has been drawn earlier. Remoteness from urban influences has been mentioned as the most likely cause for the depopulation of this area but, within the Keuper Belt, this is emphasised by an absence of main roads and by the local arable farming economy. The relatively little used Ollerton-Newark road is the only class A route traversing the area in any direction and it by-passes all villages in the area except Kneesall. With the exception of the transitory feature of the Eakring Oilfield, which has itself had surprisingly little effect upon local population trends, this area remains one of the largest tracts of uninterrupted farmland in Nottinghamshire. This in itself is an explanation of the decrease for machines have replaced men in the great arable fields and the men have moved elsewhere.

Similar conditions of declining population do in fact prevail over most of the area continuing still further northwards to the fringes of Retford but the pattern of decline is disturbed here by a reappearance of the market garden economy in the parishes of Tuxford, East Markham and Askham, primarily to serve the Retford and Coalfield markets, and also to the line of the Sheffield-Lincoln road between Darlton and Elkesley. Both of these factors produce population increases. Curiously, no similar pattern of increase is reflected in the parishes along the line of the Great North Road to the north of Tuxford. Isolated pockets of substantial decline can again be related to the effects of the closure of large houses—as at Eaton (—28%) where in 1951 the hall was in process of conversion to a training college or at Grove (—27%) where the hall, fully occupied in 1931, is now completely demolished.

Retford itself increased by 15% (i.e. 2,087 persons) emphasising again the trend of urbanisation at a rate comparable with that of its sister town of Newark. Small dormitory developments can be traced northwards at Hayton and through Claborough along the main road to Gainsborough. The high increase at Babworth to the west results, as in adjacent Coalfield areas, from continued occupation of a wartime camp.

The northernmost tip of the county is characterised by moderate increases of population in both the Keuper and Carrland areas. Separate definition of the small but physically distinct Carrland region is not possible on a parish basis. It has clearly experienced similar rates of modest increase to those of the adjoining Keuper countryside, except at Finningley where new housing for the local airfield provides the northernmost example of Nottinghamshire's many pockets of highly localised population increase.

CONCLUSION.

The 1951 census has been taken as showing that a re-population of rural areas is in progress. If this is the case then numbers are small and arise mainly from either the urbanisation of rural areas or the housing shortage which checks migration to the towns. Events in Nottinghamshire since 1931 as examined here act as a corrective on too facile an interpretation of the census changes. The outstanding feature of population change in the county over the past twenty years has been the continuous and rapid expansion of the urban and industrial areas in the west of the county as compared with the relatively small increases experienced in the eastern rural areas. Greater Nottingham and the Coalfield regions together house all but 13% of the county population on two-fifths of its area. The two regions increased by over 113,000 persons since 1931, while the remaining agricultural areas of the county, in spite of some spectacular local developments, increased by 15,500 to reach a total population of only 112,000 in 1951. The increase in the industrialised and urban areas was sufficient in the brief space of twenty years to exceed the total population of the remaining three-fifths of the county. The complete urban linkage between Nottingham and the Erewash Valley towns of Derbyshire, the southward growth of dormitory villages towards the urban belt of Leicestershire and the concentration of coalfield population into the towns between Nottingham and Worksop are of far greater significance both locally and nationally than the local expansions in the rural areas—most of which may well prove to be but temporary in their effect and none of which has produced anything in the settlement pattern more significant than a small housing estate.

THE BRICKWORKS OF THE OXFORD CLAY VALE

PAMELA R. HEALEY AND E. M. RAWSTRON

The pattern of brickworks in England and Wales is very similar to the pattern of population⁽¹⁾. There are concentrations of works in south-eastern England, in Somerset and South Wales, and in an area from the Wirral Peninsula through south Lancashire and west Yorkshire to Nottingham and thence to the Black country. A small but dense concentration is located in the Potteries and finally there is a concentration in the populous area of north-eastern England.

This similarity with the pattern of population does not apply so closely however to brick production. Figure 1 shows the regional output of bricks in England and Wales in 1953. The regions are those used by the Ministry of Works except that a special region, comprising the Isle of Ely, Huntingdonshire, Bedfordshire and Buckinghamshire, has been inserted to show separately the approximate relative importance in brick production of the Oxford Clay Vale. Figure 1 indicates therefore that the brickworks of the Oxford Clay Vale, with about 35% of the national output in 1953, had a much greater share in the national total than the density of population in their immediate vicinity would seem to warrant.

(1) See maps in National Brick Advisory Council, Paper 6, *Clay Brick Making in Great Britain* H.M.S.O., London, 1950.

They appear to be an anomalous case when compared with the relationship between most of the remaining brickworks and population in England and Wales⁽¹⁾. The initial purpose of this article is to attempt to explain this anomaly but there are two other problems which deserve investigation.

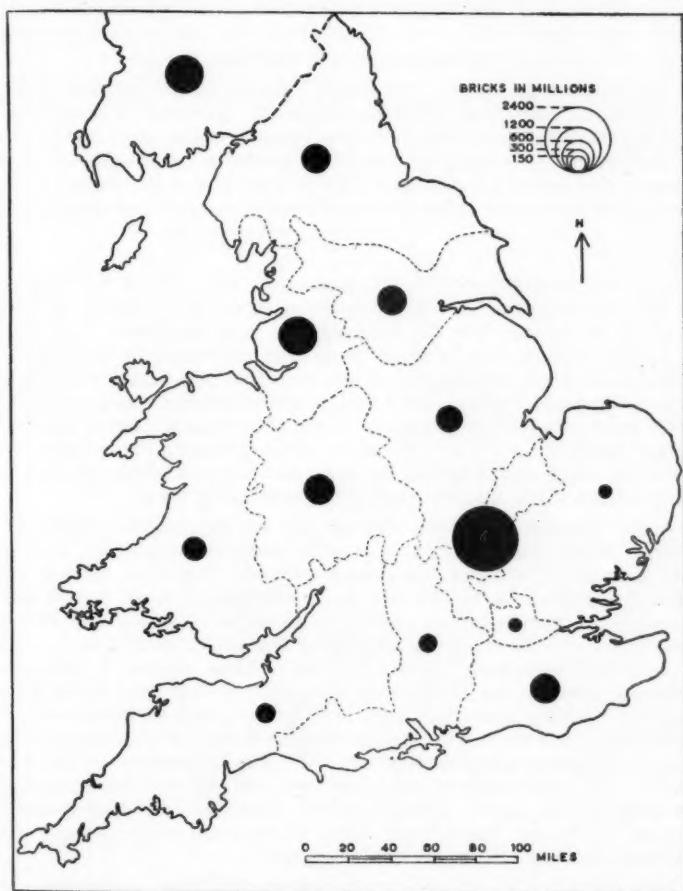


Fig. 1
Brick Production by Regions, 1953.

(1) To check fully the accuracy of this statement complete data concerning output and markets of the remaining brickworks would be needed. Although this is lacking it seems reasonable to assume that the relationship between the pattern of population and the remaining brickworks is not fortuitous and that their output is marketed locally with the exception of certain special bricks, e.g. the Staffordshire blue brick.

Within the Oxford Clay Vale the leading producer is the London Brick Company whose works make about 5/7ths of the bricks produced, i.e. 25% of the national total in 1953. Figure 2 shows the approximate weekly output of the four groups of works belonging to this company. The two problems relate to this pattern. The first is to attempt to find the reason for the concentration of the works in four separate localities and the second is to investigate the disparity of output among the four groups.

EXAMINATION OF FACTORS

The major economic requirements, relevant to the location of brick production are clay, coal, labour and market. Each has a geographical pattern and the greater the correspondence between any one of these and the pattern of brick production the greater is the likelihood of the existence of a causal relationship. Each economic requirement will be examined in turn in an attempt to find such *prima facie* relationships.

Clay.

Clay brickmaking must take place on or very near a clay deposit. The cost of production increases rapidly with distance from a clayfield. The greatest distance possible economically is of the order of five miles and applies only to bricks made from clay extracted in mining coal. A brickworks using colliery clay would probably be located at a colliery which, while providing fuel, would be chosen because it was a reasonably central point at which to assemble waste clay from a number of neighbouring mines⁽¹⁾. These conditions are, however, exceptional and brickworks using clay quarried for itself and not as a waste product are usually within a few hundred yards of the working face.

Clays suitable for brick-making are of frequent occurrence in Britain. Where they are not available some other natural building material is usually at hand. On general grounds, therefore, there is little apparent incentive for brickworks to be established more than a short distance from the consuming centres. Indeed in those parts of Britain where bricks are the traditional building material the local brickworks and local self-sufficiency were the rule. Thus although geological conditions, through the medium of comparative cost, may have determined the building materials used in different parts of the country in former times, they did not decide the relative output of building material from the different geological deposits. This was determined by the local demand: the advantage of one clay over another had comparatively little effect on the degree of exploitation. The relatively higher cost of transport in former times must have outweighed any inherent cost advantage possessed by a particular deposit⁽²⁾.

The Oxford Clay in the south-eastern Midlands possesses such inherent advantages. It is eminently suitable for the manufacture of bricks by the "semi-dry" process which requires a harder clay than other methods and a thick deposit of this type occurs in this part of the

(1) An example of this type exists at Watnall near Nottingham. The colliery at the site was, however, closed a few years ago.

(2) The relative cheapening of transport costs in the course of time and the introduction of technical improvements in the manufacture of bricks resulted in increased concentration of production to obtain economies of greater scale, but it appears unlikely that these changes materially affected the relationship between brick production and the local market before the beginning of the 20th century.

Oxford Clay series. The semi-dry process requires no drying before firing thus reducing manufacturing costs ; but it needs a larger amount of capital equipment and is not therefore economical at small works. The potential economic advantage of the omission of the drying process cannot therefore be realised without a reasonably large market.

A second advantage of the Oxford Clay is its carbonaceous content which is generally between five and ten per cent. This reduces the amount of coal needed and consequently the cost of production. Thus, given a large enough economically accessible market to permit large-scale production, the Oxford Clay in the south-east Midlands is the cheapest medium for the production of common bricks in Britain.

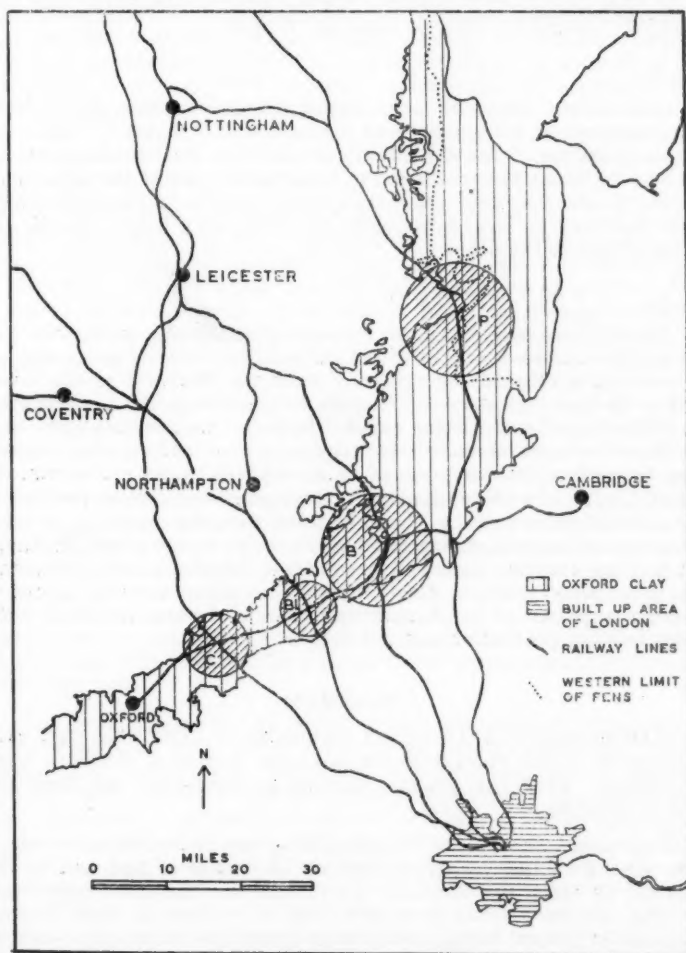


Fig 2
Weekly Output of the Four Major Groups of Works on the Oxford Clay.
The circles are proportional in area to weekly output :
P—Peterborough, 15 millions ; B—Bedford, 14½ millions ; Bl—Bletchley, 3½ millions ; C—Calvert, 5 millions.

Coal.

Although the amount of coal needed by the brickworks on the Oxford Clay is proportionately less per unit of output than at most other brickworks a large quantity is nevertheless required. The Peterborough and Bedford groups of works each probably consume about 1,500 tons of coal a week. The coal comes from Midland fields especially from Nottinghamshire and clearly the distance must involve extra transport costs when compared with brickworks on the coalfields. It does not imply greater coal cost, including transport, as a proportion of the total cost of brick production on the Oxford clay, but it does imply that care must be taken to choose sites for the works such that transport charges are kept as small as possible.

Labour.

The labour needs of large brickworks are considerable, several thousand workers being employed at both Peterborough and Bedford⁽¹⁾. For the most part it is not highly skilled so there is no tendency for the industry to become concentrated in a particular part of the country for reasons of labour supply. Once the general location has been chosen for other reasons, the local availability of labour may help to decide the choice of detailed location.

Market.

Clearly local markets cannot have been responsible for the development of the large brickworks of the Oxford Clay Vale. Just as coal has to be brought considerable distances from the Midlands so the bricks have to be sent considerable distances to markets in the London area, the Midlands and even further afield. The major market has clearly been London whose vast expansion since the beginning of the present century must have absorbed thousands of millions of the bricks made from the Oxford Clay. Notwithstanding this enormous market it must be stressed that the works are between 35 and 65 miles from the outskirts (in 1900) of London and similar distances from the major towns of the Midlands, and that brickmaking clays exist nearer both London and the Midlands. This point aside, however, the Oxford Clay is fairly centrally placed to supply a large part of the demand for bricks in the southern half of the "axial belt" of population and industry.

CONCLUSIONS

Having examined the factors it remains to show what part each plays in the choice of location for this large portion of Britain's brick production. First the general location is considered and then the detailed location.

Labour is unimportant in determining the general location which must depend on the quality of clay, on the source of coal and on the market. Of these the clay and the market are the more important. The clay makes possible such low costs of production that Fletton bricks are at present being used in large quantities for interior work on the Portland Building of the University of Nottingham. Including

(1) Considerable amounts of foreign labour are now employed at these plants.

delivery charges they may cost slightly less and certainly no more than locally made common bricks. Thus the size of the market which can be economically supplied is potentially enormous and although initially production was intended for London, today much of the southern half of England lies within economic range of the Oxford Clay works. Clearly it is the property of the clay for making very cheap bricks coupled with its position relative to a large part of the national market which determines its extensive use : but one wonders what would have been the effect had the clay been nearer the coalfields and further from the concentrated market in London. Similar large scale exploitation would probably have taken place, perhaps at a somewhat later date, but it is much more doubtful if there would have been so great a development had the deposit occurred south of the Thames. At least it is certain that both the cost of production would have been higher there on account of the greater cost of coal, and the Midland market would have been far less accessible. The anomalous general location is therefore a result first of the quality of the clay, second of its position relative to the market in London and latterly that in the Midlands too, and third, of its position directly between source of coal and London.

The reason for the choice of detailed locations involves coal supply, market and labour. All four groups of works were established before the extensive use of road haulage⁽¹⁾. They relied therefore on the railways for receipt of coal and dispatch of bricks, hence their occurrence at or very near points where the main railways from the Midland coalfields to London cross the Oxford clay. It would be asking too much of coincidence to believe that the detailed locations were determined by greater local thickness, accessibility or better quality of the clay at just the points where the railways cross it. Clearly such locations reduce costs of transport for coal received and bricks dispatched either to London or the Midlands. But a good railway runs the length of the Vale from Calvert to Sandy and thence as part of the Eastern Region main line to Peterborough. The costs of transport would not be very different at plants set up anywhere along this line. The choice of detailed location appears therefore to have been determined by the former local availability of labour at Peterborough, Bedford and Bletchley. Calvert seems to be the exception, but one must assume that there was adequate labour available in the surrounding agricultural area or by rail from nearby small towns. Apart from labour Calvert is indeed an ideal site on both the main line from London Marylebone to Nottingham and the Oxford-Cambridge line.

The local availability of labour would seem also to determine in some measure the relative size of the works. Both Bedford and Peterborough are medium size towns and their positions on the railways crossing the Oxford Clay confirm their suitability for the two largest groups of works. Bletchley is small and in addition lies on a main line (London Euston to Birmingham and Crewe) which does not pass through the East Midland coalfields. This would not appear to be very important for there are more or less direct branch line connections with the East Midlands via Rugby, Northampton and even Bedford. Calvert's comparatively poor labour supply has already been mentioned, but the

(1) Peterborough—extensive development from 1890 ; Bedford district—some development before 1910 but most since 1925 ; Bletchley—before 1914 ; Calvert—1910.

slightly greater size of the works there than at Bletchley may perhaps be related to the direct railway connection with the Nottinghamshire coalfield. Probably, however, the smaller output from Bletchley is little related to geographical conditions but rather to the nature of early development, namely by several smaller works rather than one large one as at Calvert.

Today road haulage is used for the transport of 50% of the bricks and some of the coal, road transport of bricks being the chief method up to distances of 85 miles from the works. This must provide considerable economies in transport costs to and from the Midlands because the same lorries are used for both purposes. Since road transport releases the brickworks from total dependence on the railways, the detailed location of any works established in the future must depend more on the availability of labour than upon any of the other factors.

THE WORKS IN THE PETERBOROUGH DISTRICT.

It was at Fletton near Peterborough that bricks were first made in Britain by the "semi-dry" process and it was the name "Fletton" which came to be applied to the type of brick produced throughout the Oxford Clay area from Calvert to Peterborough. Production of bricks in increasing quantities at Peterborough dates from about 1890 and today there are fourteen works in the district. Formerly each was an independent concern but, through amalgamation after 1920, most of the output is now controlled by the London Brick Company. There is thus a contrast between the Peterborough group and the Bedford group, the former comprising a considerable number of comparatively small works and the latter comprising one huge one, Stewartby, and only a few smaller works. The Stewartby works is, however, a much later development (1925) and was built by the London Brick Company itself.

Nine of the works in the Peterborough district have sites south of the town on a narrow tract of land between the village of Fletton and Yaxley station. They flank the main railway line and seen from the trains appear at first as a veritable forest of tall brick chimneys. Apart from the works themselves and their clay-getting equipment the other striking features of the landscape are the sheets of water in the old quarries and the intricate network of standard gauge lines from the works to the main line, and narrow gauge lines to the working faces.

To the south-west of Yaxley village is the Norman Cross works which is notable in having no rail access. North-east of Peterborough are two works at Dogsthorpe and Eye, both on the railway from Peterborough to Wisbech. The remaining works are in the neighbourhood of Whittlesey on "islands" of Oxford Clay within the surrounding fenland deposits. These works too are adjacent to a railway line (Peterborough-March branch). Apart from Norman Cross it is probable that the works further from Peterborough found the railways useful in bringing labour from the town as well as for the handling of coal and bricks.

EAST MIDLAND RECORD

STAMFORD IN 1850 AND TODAY.

No town in the East Midlands and not many elsewhere in England can compare with Stamford in its high proportion of stone buildings of elegant and dignified architectural style dating from medieval and later times. To an exceptional degree through the centuries Stamford has relied upon local building materials provided by the rocks of the Inferior Oolite Series i.e. the freestone of the Lincolnshire Limestone and the Collyweston "slates" which are thinly-bedded siliceous limestones affording an effective and beautiful roofing material. In a recently published book, *Stamford in 1850* by E. Hodgkinson and L. Tebbutt, which presents a fascinating portrait of the town in the early Victorian age there are reproductions of Speed's plan of about 1600 and the excellent town map of James Knipe dated 1833. For comparison, the two maps, having been brought to approximately the same scale, are presented on the same page. Knipe's survey, originally on a scale of 19.2 inches to the mile, naturally suffers from the severe reduction but the comparison gives a striking impression of continuity in the urban form and pattern. The walled circuit of medieval times enclosing the town, except for the *extra-borough* quarter of St. Martin's across the Welland, still sharply defined its limits in Speed's time though a slight extension outside the Clement Gate along the north road had appeared. By 1833 the limits of Stamford remained substantially the same though to accommodate its population of 7,000, compared with a probable 3,000 in 1600, building within the walls had been greatly intensified especially during the eighteenth century. The essential differences between the two maps are the considerable growth by 1833 in the St. Martin's area and a further expansion northwards, actually reaching to the Oakham road. Two other features outside the old perimeter shown on Knipe's map are the Rutland Terrace, on the Uppingham (now Tinwell) Road, Stamford's concession to the Palladian vogue, built in 1831, and the town gasworks on the south-east side.

By 1850, with a population of 9,000, Stamford was about to break beyond its historic confines although for sometime later building continued to rely on the traditional stone. Only towards the close of the century did the use of brick and other materials become general in suburban development. Thus the intermingling of stone and other materials in the old town has been largely avoided and Stamford presents today a uniformity and perfection of stone almost without parallel. Efforts on the part of both public and private authorities to preserve the character of the old town have been unusually successful. In 1947 a society known as the Men of the Stones was founded to promote interest in the preservation of the town, the continued use of stone, and to furnish advice on problems of building design, renovation and so on. For an exhibition arranged by the society a few months ago, a map of Stamford (based on the O.S. 25-inch sheets) showing types and distribution of building materials was prepared by members of the University of Nottingham Geography Department. The following categories were distinguished: (a) stone, (b) plaster, cement or colour-wash simulating stone, (c) red brick, (d) other brick, chiefly yellow, (e) brick with plaster, pebble-dash, etc., (f) half-timber, (g) other materials.

The survival to the present day of the stone-built area within the old perimeter and in the St. Martin's quarter is depicted with striking effect. Within this area besides a number of renovations carried out in stone, several new buildings have been erected in stone in recent years, including a factory office-block and a public-house. On the other hand it is to be regretted, though in many respects understandable, that to accommodate an increasing population (now over 10,000) and to reduce obsolescent housing, it has been necessary for suburban development, including local authority dwellings, to be carried out in the usual variety of modern materials. This new phase is also made glaringly evident on the map.

The remarkable feature of Stamford is the preservation of so much of the traditional, despite continued adaptation to the needs of each period in its history. While for particular reasons the town did not experience the large-scale industrialisation which affected neighbouring places such as Grantham and Peterborough, it hardly warrants the term 'fossil town' recently accorded it by a historian. Stamford has in fact remained an active market-town, service-town and small industrial centre.

K.C.E.

THE WARM DRY SUMMER OF 1955

The summer of 1955 was warm and, except for the first half of June, very dry. It formed a marked contrast to the conditions prevailing in the summer of 1954, which was dull, cool and very wet.

Warm summer weather in England is frequently associated with a movement north-eastwards of the Azores anticyclone to embrace much of England and north-west France. This did not occur in 1954 and the Atlantic depressions took a more southerly track. In 1955 the Azores anticyclone linked up with high pressure over Scandinavia by a belt of high pressure across Britain. This gave a remarkable prevalence of winds from between north and east over England to the south of the axis of the high pressure belt. Disturbed conditions during the first half of June caused considerable rain in Nottingham, the Woodthorpe values being 0.37 in. on June 6th, 0.96 in. on the 7th, 0.93 in. on the 11th and 0.42 in. on the 12th. These four days accounted for 2.68 in. out of the month's total of 3.59 in. From the middle of June till the end of August conditions were persistently anticyclonic apart from a break in the first four days of July. July was a very sunny month with 237 hours at Watnall (Daily Weather Report). August was very dry and warm, but sunshine was considerably less (146 hours). This was due to cloud from the North Sea coming in at night with the north-east winds and causing cloudy mornings followed by sunny afternoons and evenings.

The exceptionally warm August of 1947 was associated with an anticyclone over Scandinavia, and resembled that of 1955. In the former case, however, the prevailing wind was easterly and this slight difference brought greater warmth and more sunshine than the north-east winds of 1955.

Though July and August were very warm, no exceptionally high temperatures occurred in Nottingham, but in the west and south-west high readings were recorded, such as 88°F. at Bristol and 90°F. at

Chivenor in Devon. In warm weather with a west or south-west wind the highest temperatures are usually found on the eastern side of England.

The table gives some data for six notable summers, and also for the cold wet summer of 1954. As fine summer weather continued into September the figures are for the four months June to September. The temperature and rainfall figures are for Woodthorpe in 1955, 1954, 1949 and 1947, for Burford Road, Nottingham in 1933 and 1921 and for Trent Lane, Nottingham in 1911. The sunshine values are for Watnall in 1955, the Castle, Nottingham in 1954, 1949, 1947 and 1933, and Trent Lane, Nottingham in 1921 and 1911.

NOTABLE SUMMERS (JUNE TO SEPTEMBER)

Year.	Warmest Day °F.	Mean Temp. °F.	Mean Max. Temp. °F.	Mean Min. Temp. °F.	Mean Diurnal Range °F.	Days of 70° +	Rain in.	Rain Days	Days with Thunder	Sunshine hours	Mean Barometer mbs.
1955	84.3 July 14	60.3	69.5	51.1	18.4	59	5.59	33	6	662	1019
1949	91.1 July 12	61.6	71.3	51.9	19.4	66	7.22	35	6	726	1019
1947	89.0 June 3	61.9	71.4	52.5	18.9	71	5.51	43	6	654	1016.5
1933	87.6 Aug. 24	63.3	71.8	54.8	17.0	73	6.05	43	10	800	1017
1921	90.4 July 10	60.6	69.8	51.4	18.4	53	7.33	34	4	779	1020
1911	94 Aug. 9	61.2	71.8	50.6	21.2	?	5.69	44	?	?	?
1954	83.7 Sep. 1	56.7	64.1	49.4	14.7	19	14.61	79	10	503	1011.5

The dryness of the summer of 1955 was more noteworthy than the warmth. July, August and September each had less than one inch of rain, and totalled only 2.00 in. between them. It would appear that this is the smallest rainfall total for the three months July to September in Nottingham since records began in 1867. The impact of summer weather on the public mind appears to be influenced more by the mean maximum temperature than by mean temperature, and by the number of warm days (70°F. and over). As regards rainfall, frequency has more influence than quantity. The unsettled July of 1954 had less rain than the average but more rain days.

The present century has had more notably warm summers than the second half of last century. The official temperature averages now in use by the Meteorological Office are for the 30 years 1921-1950, and they show that the mean temperatures of the summer months (June to August) are higher than those of the 1906-1935 averages previously in use. The increase in mean temperature for the three months amounts to 1.0°F. at the Castle, Nottingham and 0.7°F. at Kew.

A.B.T.

THE EXPANSION OF DAVENTRY

Daventry is a typical country town, twelve miles west of Northampton on the main London to Birmingham road, and the general service centre for a large part of western Northamptonshire. Its population has increased only slightly in the last eighty years and was 4,078 at the 1951 census.

In 1954 industry in the town consisted mainly of four firms with a total of only 600 workers. A large old-established footwear firm and a small clothing factory were both in existence before the war and in 1941 a London engineering firm established a plant which is now an important employer of labour. Originally a branch factory it has now become the main works and the parent plant in London has been closed. The success of this firm contrasts with other wartime industrial ventures which failed to survive in and near the town after the war. The fourth plant in existence in 1954 was a small branch factory set up in 1953 of the Birmingham engineering firm, British Timken.

This industrial development has helped to check migration from the Borough and latterly to induce immigration. The initial plans after the war were to foster this trend and envisaged a considerable growth of the town. Subsequently the London County Council and the other local authorities involved agreed to make Daventry an "expanded town" to receive some of London's overspill population.

Building has begun and an area of about 70 acres is being developed to the north-west of the town as a new neighbourhood unit with about 700 houses and a full complement of daily facilities. Most of the overspill population is intended to come to this area. Adjoining the neighbourhood unit on its northern side is an area of similar size under development by British Timken as the site for a large works to produce tapered roller bearings. This is planned to provide employment for 500 workers by the end of 1955 and a further rapid increase is envisaged thereafter. The future growth of this one firm provides the occupational basis for much of the immediate expansion of the town. Indeed 175 houses in the neighbourhood unit have already been allocated to British Timken by the Local Authority compared with a further 15 to the other local firms.

British Timken chose to locate their new plant in the town partly because of its nearness to their existing works at Northampton, partly because of the facilities available in Daventry and partly for reasons of labour supply even before London overspill was contemplated. It had been ascertained that quite a number of people were travelling from Daventry to Rugby and Coventry to work and that there was labour available in the rural area of which Daventry is the natural centre. Thus it seemed likely that sufficient labour was available locally provided key workers were brought in to start the plant: some seventy of these and their families from Birmingham have already been housed. The subsequent decision to settle about 3,000 of London's overspill population in the town will make it even easier to satisfy the labour needs of the new plant.

The rapid application of such development to a small country town appears to set two problems, firstly how to prevent the town being swamped by immigrants from one particular part of the country and thereby losing much of the town's original identity, and secondly to guard against the possible dangers of too great a dependence on one type of industry. It should be noted, however, that the migration from

London of 3,000 people is less than the normal for other places planned as "expanded towns". The first problem has, therefore, been foreseen and London's contribution is intended to provide the greater part of Daventry's expansion only at the outset. It is possible that the second problem may ultimately arise; equally, increasing population may well create in a few years greater industrial diversity than exists even at present. In any case the likelihood of the problem arising is as yet too remote to warrant detailed consideration now.

I.G.W.

BELL-FOUNDING AT LOUGHBOROUGH

Of the very few bell-founding centres now in existence in this country, that at Loughborough provides an excellent illustration of the change in conditions affecting the location of the industry from earlier times to the present day. Though the earliest bells were probably made of rivetted metal plates, casting was certainly common practice in medieval times. There were however relatively few centres in which bell-founding was a permanent activity as in London, Reading, Norwich, Gloucester, Nottingham and Leicester. Generally bell-founders were more or less itinerant craftsmen moving about the country, setting up temporary foundries wherever bells were required. Hinrichsen's *Musical Year Book*, Vol. VII, 1949-50 gives a list of bell-founders in England of whom records exist from the 13th century onwards, together with the dates and location of their operation. Well over 500 names are recorded up to 1850, and 75 of these occur before 1500. In some places, such as those mentioned above, foundries continued to operate intermittently for long periods, being worked by several generations of the same family. In medieval times bell-founders were known as "bellyeters" and in London the survival of Billiter Street near Aldgate implies their former concentration in that quarter of the city.

Over the country as a whole the use of streams for transport favoured sites on, or close to, a river bank for the erection of a foundry. Thus from time to time in the sixteenth and early seventeenth centuries, bells were made at Narrow Marsh, Nottingham, on the bank of the Leen, a small tributary of the Trent. Here in 1610 Henry Oldfield undertook to make the large bell for Lincoln Cathedral, and for this task he obtained the co-operation of one of the Newcombes of Leicester. For the actual casting the two set up their foundry in the Minster Yard at Lincoln. The casting of "Great Tom" (about 4 tons), thus affords a good instance of the itinerant nature of early bell-founding. The present bell, cast in 1835, weighs about 5½ tons.

Medieval foundries at Leicester provide historical links with the modern works at Loughborough. About 1365-70, bells were cast by John de Stafford in Leicester and his successors maintained the craft for centuries, one of whom opened a foundry at Kettering soon after 1710. Later, one of two brothers in charge of this centre set up another foundry at St. Neots. Here an apprentice named Robert Taylor acquired the foundry in 1784. His son, John Taylor, after acquiring his skill at St. Neots, began making bells at Oxford and also operated a foundry in Devon from 1825 to 1833. From Oxford he came to Loughborough in 1840 to re-cast the bells of the parish church. But further contracts came to him at Loughborough and a permanent industry, growing to a

considerable scale, soon resulted. The day of the itinerant bell-founder had passed. What happened at Loughborough occurred elsewhere. With the age of steam, improved foundry methods and better communications, larger units proved successful and bell-founders concentrated their activities in one centre.

Since the industry is concerned with a product for which the demand is limited, there is scope only for a few participants. Thus the industry is now almost entirely carried on by three concerns at Loughborough (the largest), Whitechapel and Croydon.

The works at Loughborough founded by John Taylor remains a family business, employing about 50 men. The locational advantages of Loughborough remain as effective as they were a century ago. The position of the town in central England is particularly favourable both for distribution of the products, (especially as the actual hanging of bells, which requires great skill, must be done by the makers), and for maintaining business contacts on a personal basis. For the export of such relatively high-cost products the inland situation is no handicap. Moreover the essential materials lie close at hand. Coal, which superseded wood, chiefly oak, as the furnace fuel, was obtained from the Derbyshire field, and for many years the Kilburn Seam has proved the most suitable. Moulding sand from the Lower Mottled (Bunter) Sandstone is obtained from Mansfield. Supplies of metal are bought from metal merchants who serve many industrial centres in the Midlands. Bell-metal is a mixture of copper and tin in the ratio of 3 : 1, and although early bell-founders adopted a ratio of 4 : 1, the higher proportion of tin in modern bells makes them superior in tone and resonance. The quality of craftsmanship, however efficient the equipment may be, is still of great importance and the world-wide reputation of the Loughborough factory is due in part to the fact that it remains a family firm maintaining intimate relations with its skilled employees.

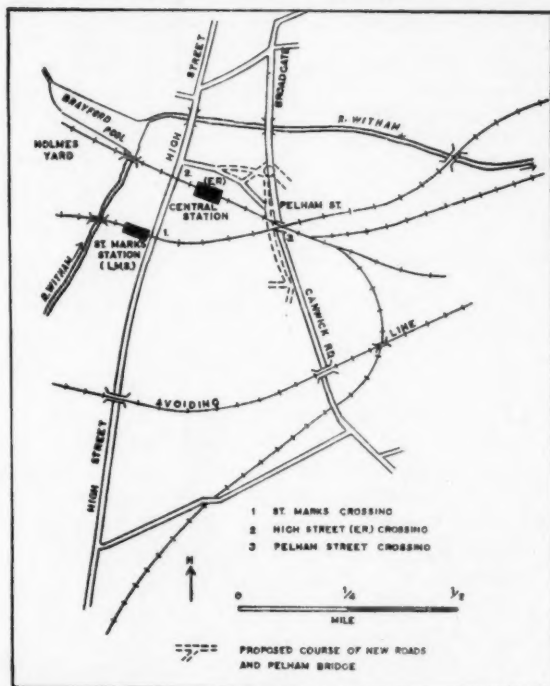
K.C.E.

LINCOLN : THE PELHAM BRIDGE SCHEME

The essential feature of Lincoln's nodality has been expressed at least since Roman times by the crossing point over the River Witham. Even today there are but two main north-south routes crossing the river in the city, and there are no nearby alternatives outside the city. Congestion in the industrial and commercial parts of the city is thus increased by through traffic, for, according to the Origin and Destination Survey of 1947, one-third to one half of the total traffic was "by-passable".

Railway crossings aggravate the traffic problem; two of these cross the High Street and another crosses the alternative through route along Canwick Road, Pelham Street and Broadgate (See map). During the census hours (6 a.m.—10 p.m. daily, 21—26 July, 1950), road traffic was unable to use the High Street crossing for almost a quarter of the time and the Pelham Street crossing for almost a third. All but a few of the trains using the midland line from Nottingham terminate at Lincoln, so that the St. Mark's crossing is little used. The other two main crossings however are situated at either end of the Central Station. All trains passing through or calling at this station have to use both crossings. "Light" locomotives and much empty rolling stock have to cross the

High Street to get to the Holmes Yard (goods), and the new diesel trains when not in use are placed in sidings on the eastern side of Pelham Street. Shunting on the crossings is a third cause of delay to road traffic, especially in the case of the Pelham Street crossing where the Midland line joins a series of four Eastern Region lines actually on the crossing. Although the high level avoiding line which can serve through trains using the Boston, Spalding, York, Retford and Shireoaks lines only, relieves the crossings of some rail traffic, the effect is limited.



The Report of the Survey of Lincoln (1951) put forward three proposals for reducing traffic congestion : a by-pass to the east of the City, an alternative route parallel to and west of High Street (crossing the railway and the western end of Brayford Pool by viaduct), and a bridge over the railway near the Pelham Street crossing. Considerable progress has been made towards carrying out the last proposal. In February 1955 the City Council approved the Pelham Bridge Scheme and in May 1955 the Ministry of Transport agreed to contribute £400,000 out of a total estimated cost of £688,000. The scheme involves the construction of a bridge 1,200 feet long to cross the railway and the Sincil Drain, the building of a link road between the northern end of the bridge and the High Street and the total closure of the Pelham Street crossing to road traffic. At the moment the High Street route is the busier one, but the opening of the bridge should divert traffic from this main shopping street. It is hoped to complete the bridge in 1958.

D.R.M.

HIGHER DEGREE THESIS AND FIRST DEGREE DISSERTATIONS, 1955

Prepared in the Department of Geography.

In the University, Geography may be read as a subject in the Faculty of Arts, under the Board of Studies in Law and Social Science (Faculty of Arts) and in the Faculty of Pure Science. Since the award of the Charter to the University in 1948 all students taking an Honours degree in Geography have been required to submit a dissertation as part of their final examination. Only those dissertations and higher degree theses relating to East Midland subjects are listed below. *Bona fide* students or research workers may be permitted to consult them on application to the Department. Titles of higher degree theses and first degree dissertations presented in the years 1950-53 were published in No. 1 and those of 1954 in No. 2.

1955

M.A.

The Peak District National Park ; A Regional Study of an Amenity Area. J. G. Mosley.

DISSERTATIONS

Some aspects of the River Trent. Patricia I. Bennett.

The differential development of Bolsover, Clowne and Barlborough, with special reference to the Permian escarpment. Mary L. Frith.

Some aspects of the historical geography of the Borough of Louth, and a survey of existing conditions. H. E. Goulding.

The geographical aspects of open-cast coal mining. G. G. Hare.

Urban morphology of modern Leicester. C. R. Harrison.

Factors in the location of an extractive industry. A study of the brickworks of the Oxford Clay Vale, with special reference to Peterborough and Stewartby. Pamela R. Healey.

Some features of the agricultural geography of north-east Derbyshire. Patricia Hibbert.

Settlement in central Nottinghamshire. D. G. Walker.

CORRECTION :—

It is regretted that in Dr. G. J. Fuller's article "Settlement in Northamptonshire between 500 A.D. and Domesday", which appeared in the last issue, the maps for Figures 2 and 4 were inadvertently interchanged.

